Grinding

& Finishing

The Magazine Devoted Exclusively to Abrasive Operations

WHEELS • GRINDING • HONING • LAPPING MACHINES • ACCESSORIES • PORTABLE GRINDERS • TUMBLING • ABRASIVES

★ FEATURES

Centerless Grinding

Hints on Successful Precision Barrel Finishing

Douglas Decentralizes Grinding

The Foreman and Arbitration

DECEMBER 1955

MID-WEST

. . . the one source for all your abrasive needs

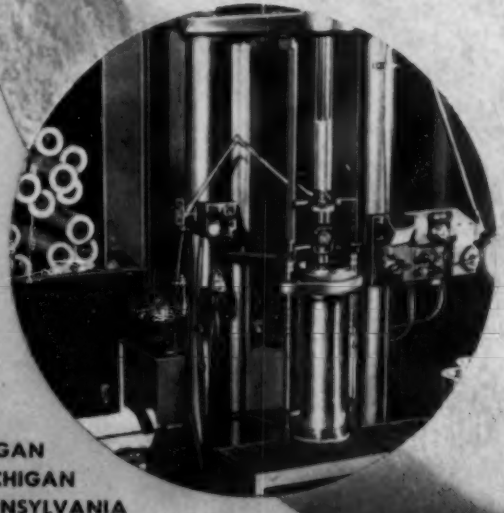
Producers of Quality

- COATED ABRASIVES
- GRINDING WHEELS
- HONING STONES
- ABRASIVE GRAIN

MID-WEST ABRASIVE CO.

Executive Offices:
510 S. Washington St.,
Owosso, Michigan

MID-WEST QUALITY ABRASIVES



Factories at:
OWOSSO, MICHIGAN
CHESANING, MICHIGAN
ROCHESTER, PENNSYLVANIA

Branches at:
DETROIT, MICH.
CHICAGO, ILL.
HIGH POINT, N.C.
BETHLEHEM, PA.
PITTSBURGH, PA.
LOS ANGELES, CALIF.

Encircle No. 274 on postpaid card

DEC 20 1955

DECEMBER, 1955 — VOL. 1, NO. 8

Grinding and Finishing

Contents

Editor's Page 7
Tool & Cutter Department 42
Safety 54

FEATURED ARTICLES

Centerless Grinding: First of a 5-part Series 8
How the Foreman Stands up in the Arbitration Courtroom 21
by Harold R. Nissley
How to Get Best Results from Precision Barrel Finishing 26
by Morris B. Shipley and William A. Biebel
Indexing Fixture for Grinding Ratchets 39
by T. C. Bowes
Douglas Decentralized Grinding Makes Each Sharpening Crib A Specialist 42
by James Joseph
SAFETY: Grinding Safely 54
by Edmund Mottershead

SHOP HINTS AND SHORT CUTS

Precision Bushing Chuck for Grinder 24
Vertical Grinder Speeds Plow Share Output 25
Surface Grind Non-Magnetic Materials 25

DEPARTMENTS

Available Literature 50
What's New in Equipment and Materials 55
Index to Advertisers 74

EDITORIAL STAFF

William F. Schleicher, vice president and editorial director; *Jack Kenyon,* associate editor; *Ronnie Burritt,* consulting technical editor; *Richard C. Bush,* assistant editor; *V. J. Browning,* readers' service.

BUSINESS STAFF

R. C. Van Kampen, president; *Vincent C. Hogren,* executive vice president; *J. E. Hitchcock,* vice president; *Oliver S. Pepper,* business manager; *John S. Todd,* production manager; *L. M. Schroeder,* art director; *Robert L. Spreckels,* circulation manager.

Copyright by Hitchcock Publishing Co., 1955, 222 East Willow Ave., Wheaton, Ill. Phone WHeaton 8-3400. Cable Address: HITCHPUB.

Accepted as controlled circulation at Pontiac, Illinois

Improve Your Precision Toolroom Grinding with NEW

FILMATIC

FILMATIC grinding wheel spindle bearings . . . never wear out; never require adjustment

Internal grinding head . . . always in place and ready for the job; dozens of quills, spindles and collets to choose from

CINCINNATI

CENTERTYPE GRINDING MACHINES
CENTERLESS LAPPING MACHINES

In Three Ways

Cincinnati Filmatic Universal Grinding Machines

CINCINNATI

It's difficult to improve upon top performance, but it can be done. In toolroom grinding, for example, the *new* CINCINNATI FILMATIC Universal Grinders offer three-way improvement:

1 *Improved accuracy.* A new cross feed unit assures closer accuracy than ever before on your precision toolroom work; automatic pickfeed to a positive stop; .000050" minimum increment of adjustment.

2 *Improved convenience of operation.* Table and cross feed handwheels are raised to a more comfortable height; handwheels are larger; new headstock speed selector is easier to operate; push buttons are relocated for easier accessibility.

3 *Improved versatility.* Hinged internal grinding head, a Cincinnati original, has been retained and improved upon with lifetime lubrication and a wider selection of quills, spindles and collets; pickfeed at either end or both ends of table cycle; power rapid positioning (extra) for wheelhead.

CINCINNATI FILMATIC
12" x 36"
UNIVERSAL GRINDER

Other sizes: 14" and 18" swing. Between-center lengths: 36", 48", 72"

Cross feed unit . . . completely new; two-speed; pickfeed all the way to final size

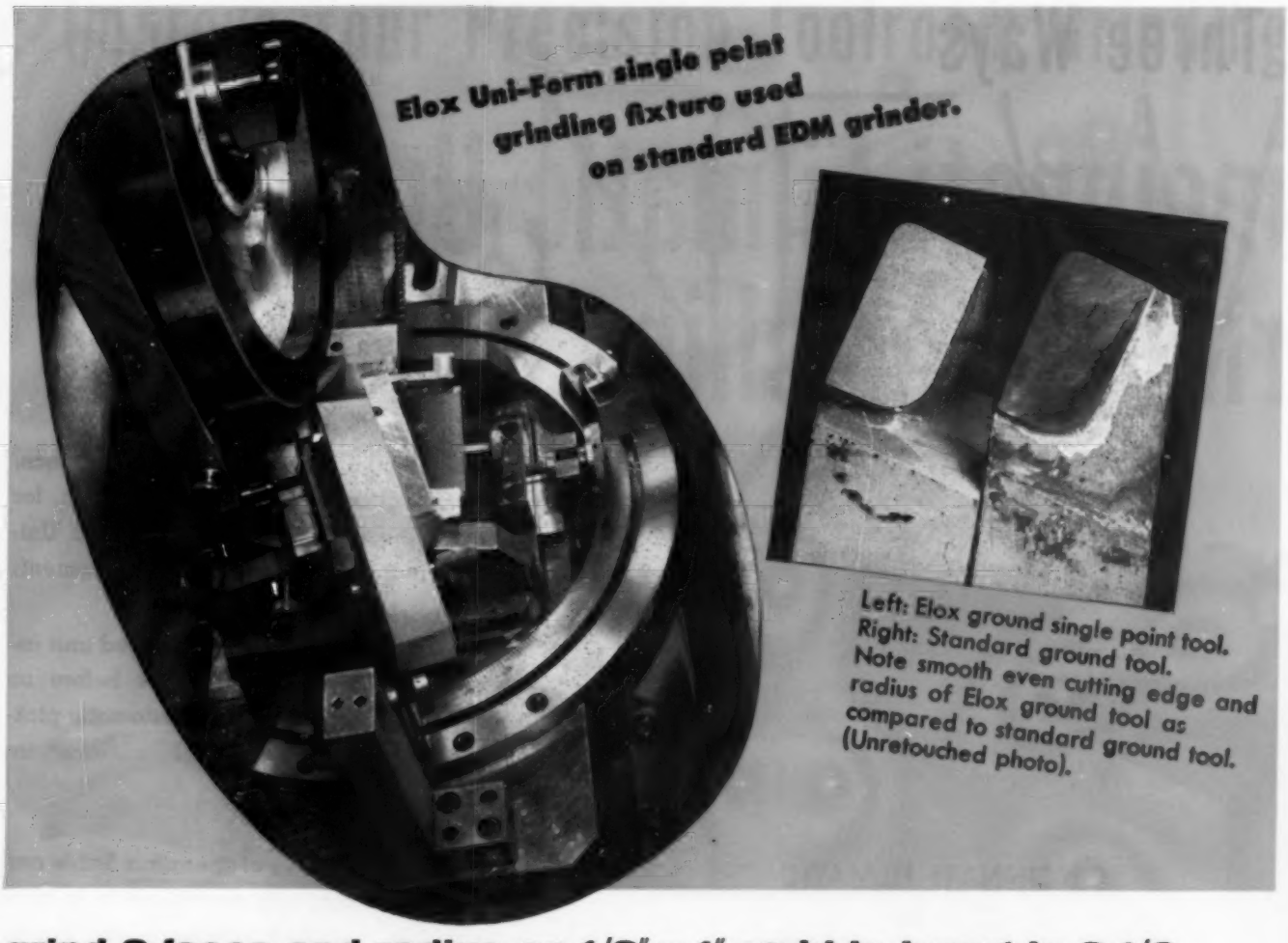
Power rapid positioning . . . eliminates tiresome hand cranking from one diameter to another

Don't forget, the above improvements in the three major requirements for precision toolroom grinding are in addition to other well-known Cincinnati advantages such as FILMATIC grinding wheel spindle bearings. That's why CINCINNATI Universal Grinders are your best buy. Get all the facts by writing for catalog No. G-663.

CINCINNATI GRINDERS INCORPORATED
CINCINNATI 9, OHIO

Encircle No. 201 on postpaid card

• CENTERLESS GRINDING MACHINES
MICRO-CENTRIC GRINDING MACHINES



Left: Elox ground single point tool.
Right: Standard ground tool.
Note smooth even cutting edge and radius of Elox ground tool as compared to standard ground tool.
(Unretouched photo).

grind 2 faces and radius on 1/2" x 1" carbide insert in 3-1/2 minutes automatically . . . repetitively . . . without variation . . . without heat checks . . . without manual assistance!

elox* corporation of michigan

720 N. Rochester Road
Clawson, Michigan

DEMONSTRATION CENTERS:
Plant—Clawson, Mich.
45 Broad Ave., Palisades Park, N.J.
1907 W. Monterey, Chicago, Ill.

Elox Electrical Discharge Machining of single point tools is an electronically controlled push button operation. Variable human elements are completely eliminated, guaranteeing every tool sharpened identical as to finish, radius. Grinding is done with a brass wheel to any pre-determined specifications. Every tool repetitively uniform!

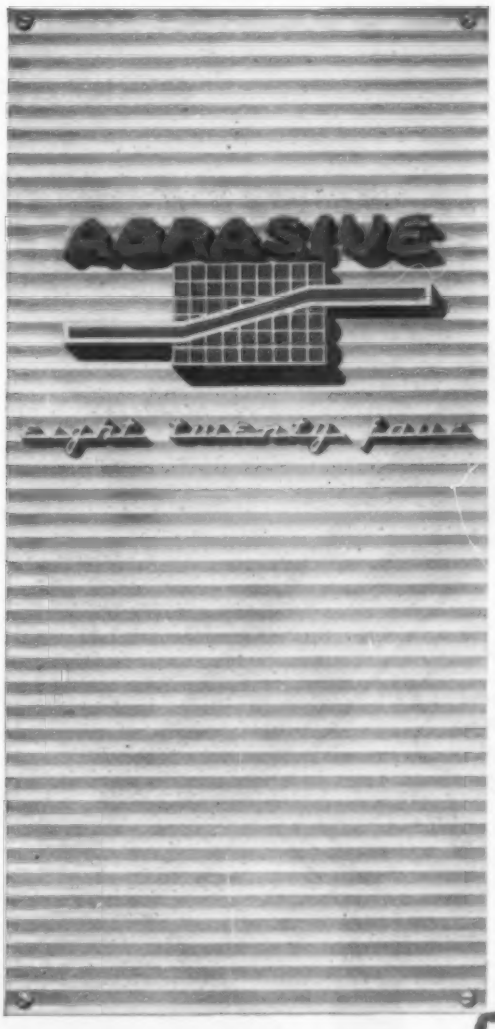
Advantages of Elox Uni-Form Tool Grinding:

- **Permits use of standard blanks**
- **Every tool is identical as to radius, finish**
- **Increased tool life**
- **More regrinds per tool**
- **Eliminates diamond wheels**
- **Carbide and tool shank are ground simultaneously**
- **Averages 40% labor savings**

See Elox Uni-Form Single Point Tool Fixture in operation at Elox Demonstration Centers.

*T.M. Reg.

Encircle No. 202 on postpaid card



You are going to see new things from

ABRASIVE

The new Abrasive name plate above gives you a hint! In 1956, our fortieth anniversary, Abrasive will introduce a number of important developments in their well known line of surface grinders. For your greatest production year, keep your eye on Abrasive pioneering in 1956.

ABRASIVE
Machine Tool Company
Dexter Road, East Providence, Rhode Island

Sorry! We can't show this revolutionary new Abrasive in detail. Look for it in 1956.

Encircle No. 203 on postpaid card

CHICAGO MOUNTED WHEELS

STILL FIRST AND FINEST

TO THE POINT, for 65 years Chicago Wheel has been first in mounted wheels, producing points that are engineered to do the job better, faster, at the lowest possible cost. Exacting production control methods provide you with a custom-built product covering every size, grain, and grade under positive density control.

Wheel guaranteed to never come loose from mandrel
CHICAGO
Positive density and grade control
When you think of mounted wheels, think of Chicago Wheel

Chicago Wheel pioneered the mounted wheel and is still the largest producer of these vital production tools. Isn't it logical that we can help you with your problem? There is a wheel to satisfy every application — in an infinite number of shapes and sizes, from the world's smallest to the world's largest. *Wheels when you want them* is but another reason why Chicago Wheel is still first.

CHICAGO WHEEL
& MFG. CO.
Dept. G • 1101 W. Monroe Street • Chicago 7

Encircle No. 204 on postpaid card

The Editor's Page

WHO, IF NOT YOU?
WHEN, IF NOT NOW?

Until recently, I have wondered why some men accomplish so much more than others in like positions. This sort of thing disturbs me greatly. These architects of mighty deeds appear to be supermen, or at best, especially endowed by nature. I look with awed eyes on those who continually find time for another project and who, easily and smoothly, appear to squeeze 36 hours out of every 24-hour day.

I found the answer in the office of a works manager with a reputation for getting things done. This manager is never too busy with his regular work for another project, or another study, to handle this matter or that, make speeches, write articles, lead meetings, or help his colleagues in their work. His counsel is sought in the conference room and he seldom leaves a meeting without another undertaking to be planned and executed.

He arrives at his desk at 8 every morning and leaves the office promptly at 5 every afternoon. He doesn't rush, and he's in the best of health.

His associates say he's very efficient, but he doesn't think of it in terms of efficiency, saying merely, "It's got to be done, so I do it." And I wonder if efficiency isn't just that, and no more: doing the job that needs doing right now. Not tomorrow, next week, or sometime when one happens to be in the neighborhood, but right now. Procrastination is the thief of time, Edward Young tells us. Every job that's put off detracts from the total of final accomplishment. A neglected undertaking digs its own grave.

The year ahead will be uncertain: if it's good you must produce more, if it's bad you must produce more economically. In any event, solemn obligations will be on your shoulders and weighty responsibilities will test your mettle. Whether you're responsible for an overall operation or a segment of it, new methods, more economical techniques, more productive tooling should be, in addition to your regular work, your business. Break the back of the project you've been dreaming about for a year right now: not tomorrow,—not the next guy—but you, right now.

This all reminds me of a sign I saw hanging in someone's office:

"Who, if not you?
When, if not now?"

This sign seems to sum up the entire question of human efficiency, and I'm having a few cards printed with this quotation to hang over the desk. If you'd like a copy drop me a line and I'll send one along.

Have a happy and healthy new year!

P.S. This little editorial appeared in the MACHINE and TOOL BLUE BOOK, sister publication to GRINDING and FINISHING, in January, 1953. Thinking some of our new friends in the grinding industry might like to read it and receive one of the cards, we are reprinting it herewith.

William F. Schleicher

CENTERLESS Grinding

Beginning a Five-Part Series on Centerless Grinding

Part 1. Advantages, Applications, Economics

Prepared by the Editorial Staff of Grinding and Finishing

ANYONE visiting the recent exhibits of the manufacturers of centerless grinders at the recent Machine Tool Show certainly came away impressed with the fact that the modern centerless grinder is as far removed from the cylindrical grinder of the Civil War as a set of fine Jo blocks is from a carpenter's rule.

The impetus given to high production centerless grinding by World War II plus the modern technology of automation has created automatic machines which grind an incredible variety of pieces to a high finish and within tolerances measured in a few millionths.

Advantages of Centerless Grinding

The advantages of using centerless grinding for producing many pieces are numerous. The grinding process, of course, is virtually continuous, because loading time, as compared to center-type grinding, is exceedingly short.

With normal between-centers grinding, each piece must be set up. Center holes must be drilled and even lapped, and each piece of work must be dogged. By contrast, with centerless grinding, only one set-up operation is required for a given run of work once the two wheels and work supporting blade have been brought into the necessary relationship. Set up time per piece is negligible. In addition, there are very significant savings in time for adjustment of machine and gaging pieces.

One essential advantage of the centerless method is that the work is rigidly supported under the grinding cut as well as the full length of the cut. No deflection takes place during the grinding operation. Long, slender pieces, fine pins, rods, and even wires, which cannot be ground between centers can be handled by this method with ease. In centerless grinding there is no axial pressure from centers, and the grinding wheel cannot cause distortion by its pressure on the work.

Further, with fear of distortion from wheel pressure eliminated, heavier cuts can be taken on a single pass, speeding up the work.

As a true floating condition exists during the grinding process, and the possibility of error in centering is eliminated, less grinding stock is required, with a corresponding gain in wheel life. At the same time the centerless grinding method tends to grind the largest possible diameter from stock, thus saving both material and grinding time.

Errors in setting-up the job and in compensating for wheel wear are reduced by fifty percent by centerless as compared with between-centers grinding, because material removal is measured on the diameter rather than the radius. Errors due to wheel wear are similarly cut in half.

Those traditional headaches of between-centers grinding, worn or dirty center points or center holes, are eliminated.

The machines themselves have been built for simplicity of operation, with very few wearing surfaces and usually with automatic lubrication of spindles.

HARDENED STEEL

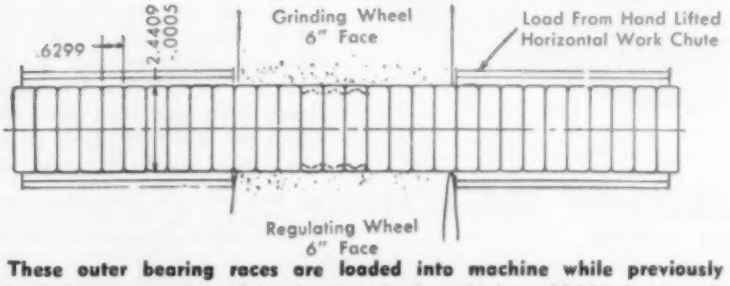
FINISH REQUIRED 10 MICRO

STOCK REMOVED .015-.025
(PER CUT .005) ROUGH
.001 FINISH

5 CUTS

ROUNDNESS AND
STRAIGHTNESS
.0002 FINISH
SIDES SQUARE WITH O.D. .0005
3800 PER HR. PER CUT (ROUGH)
3800 PER HR. PER CUT (FINISH)

THRU FEED GRIND



These outer bearing races are loaded into machine while previously loaded races are ground by the thru feed method to .0002" for roundness and straightness, and with O.D. square with sides to .0005". Production for both rough and finish is 3800 per hour.

Consequently, machine upkeep is reduced to a minimum.

Finally, large quantities of smaller size work can be automatically and continuously ground by the use of a magazine feed, gravity chute, or any of a variety of hopper feeding attachments, providing the shape of the piece will permit the use of such attachments. Even when the pieces are loaded by hand, this can often be done while another piece is being ground, thus making the operation virtually continuous.

Applications

Tolerances of .0001 in. or .00005 in. are common in production of centerless grinding. Piston pins are an example. Bearing races 1⅞ in. O.D. have been ground at the rate of 684 per hour to limits of 4 to 8 hundred-thousandths for size and with surface quality of 4 to 5 micro-inches.

Parts that are badly out of balance lengthwise, which consists of four different diameters each of short length compared to the diameters—have been ground on the large diameter by thrufeed to limits for size of ±.00025-in., and round and straight within .0002-in.

An example of wartime developments in accurate centerless grinding is the grinding of fuel injection plungers for bombers. The government specified limits of ±.000005 in., which had formerly been approached only by gage makers—and not on a high production basis. Ordinarily such close limits on machine parts would have been achieved by selective assembly which would allow the pieces to vary by a total of around .0015-in.

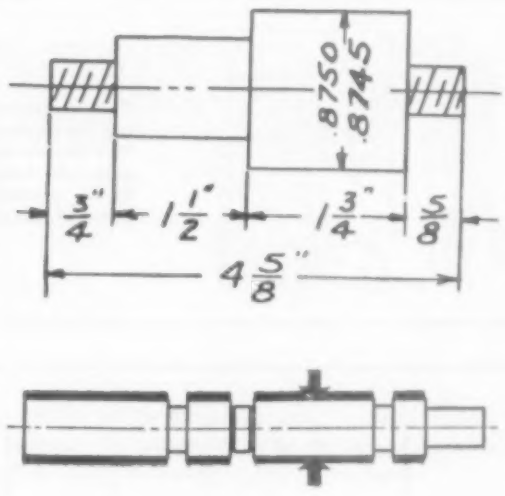
But selective assembly could not be permitted for these plungers because of the excessive inspection time required and because of maintenance and repair trouble sure to develop in the field, and yet, no existing grinder, center type or centerless, could approach such limits without selective assembly. The only possibility was to develop a much more accurate machine.

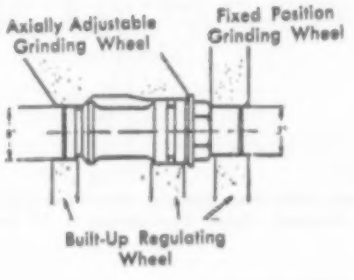
The Cincinnati centerless lapping machine had produced piston pins of great accuracy, and it was decided to start with it. To enable this lapping machine to do the job it was practically redesigned in everything but the underlying principle. Bearings, drivers and drives were changed. A thermal control device was installed to maintain constant coolant temperature, for a change in temperature of the part as slight as that caused by the heat from an inspector's hand could make the work change size to more than the allowable limits.

The grinding was done in sixteen passes to remove a total of .000525-in. of stock. The diameter reduction was about .000080-in. on the first pass, about

Top right. Although this axle support pin is badly out of balance lengthwise, 350 pieces per hour are centerless ground in a single pass to .8745"-.8750" for size and within .0002" for roundness and straightness.

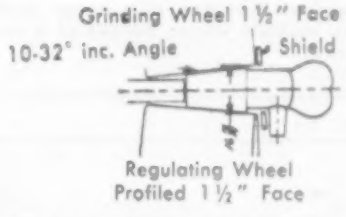
Bottom Right. The government demanded that these fuel injection plungers for B29's be ground to limits of ± .000005". A specially re-designed centerless lapping machine turned them out in quantity to ±.0000035". No selective assembly or fitting needed.



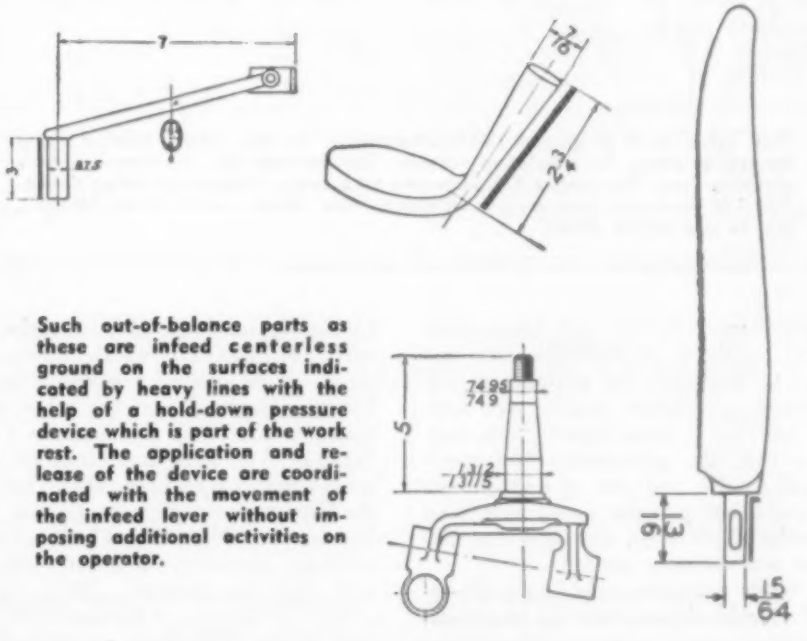


Here is a combination of multiple on formed wheels grinding three diameters, one taper and one shoulder by the infeed method. All surfaces must be dead concentric and tolerances are .0008". Production is 80-100 per hour.

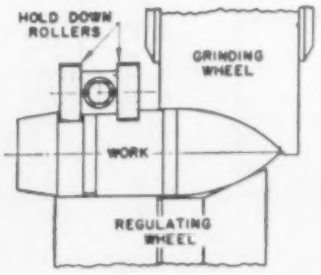
GLASS
FINISH GRIND
STOCK REMOVED .010
200 PER HR.
PLUNGE GRIND



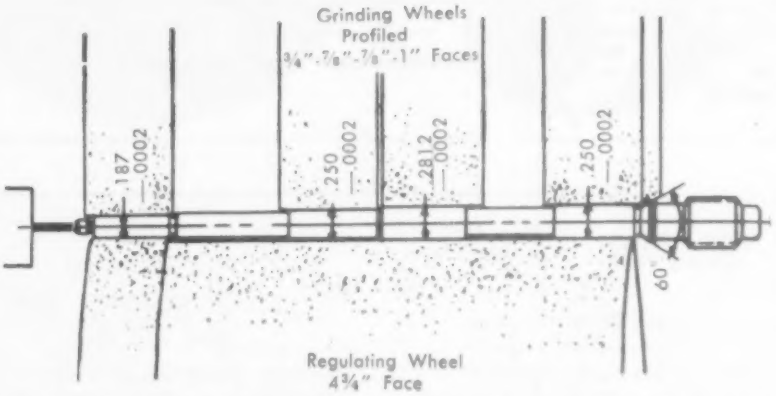
This glass stopper for chemical apparatus is ground on the taper.



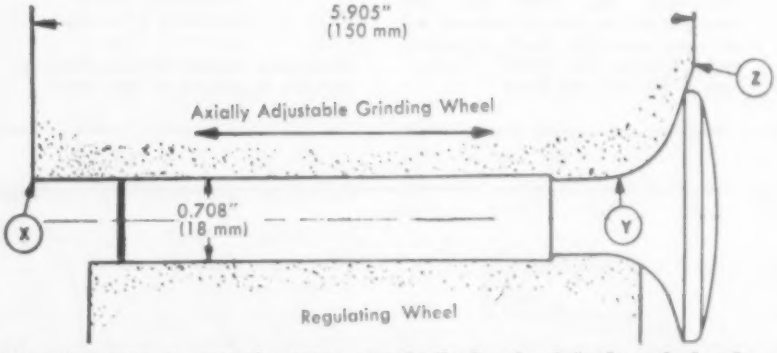
Such out-of-balance parts as these are infeed centerless ground on the surfaces indicated by heavy lines with the help of a hold-down pressure device which is part of the work rest. The application and release of the device are coordinated with the movement of the infeed lever without imposing additional activities on the operator.



This arrangement is equivalent to grinding the shell nose with a centerless chuck. It is known as "off-set centerless." Pressure rolls bear on a diameter that is not to be ground and, in effect, take the place of the grinding wheel at that point.



Here four diameters of a worm shaft are centerless ground simultaneously, using multiple wheels instead of a single formed wheel. Production is 75 per hour.



This valve stem is ground semi-automatically by the infeed method using formed grinding on regulating wheels. The surface X-Y is turned with a profiting cam. The radius Y-Z is turned by a special diamond holding device. 100-120 pieces per hour are ground with a "fine" finish, round within .00008", and to size within .0002".

.000010-in. on the last pass. Limits were held rigidly to ±.0000035-in. for size and to .000005-in. for straightness and roundness. Surface quality was kept to less than 2 micro-inches. Both were less than the government had specified. At the feed rate of 43½-in. per minute, 600 plungers could have been produced per hour, although that output was not often needed.

While not universally applicable for all cylindrical parts that can be ground between centers, centerless grinding has wide application. One shop grinds on a Lidköpnig machine, 10-in. lengths of wire, .01-in. O.D., which obviously could not be ground between centers. Using a larger size of the same machine, another shop grinds shafts 6 in. O.D. x 25-ft. long and tubes of the same length up to 12-in. O.D. One of the largest pieces centerless ground are bearing races 30-in. O.D. Clock balance staffs are ground by the infeed method, and held to between .196 in. and .199-in. for length and between .0345-in. and .035-in. O.D. They are ground in large quantities using loading magazines to get practically continuous production.

Crank shafts are centerless ground from the rough on special, heavy machines using multiple wheels. Badly out-of-balance parts can be ground by using suitable attachments. Typical are such parts as automobile steering knuckles, the tangs of table knives, shanks of golf club-heads, and shock-absorber arms.

Parts such as the nose of a shell which must be ground on a diameter other than that to which the rotative force is applied may be ground as shown.

There is no limitation as to the kind of material that can be ground. Among the non-metallic parts being successfully centerless ground are golf, pool and bowling balls; spark-plug cores; fountain pen barrels and caps; glass bottle stoppers and chemical apparatus; carbon electrodes; rubber washers; plastic rods, tubes and casters; wood rolls; and even cork.

Centerless Grinding Economics

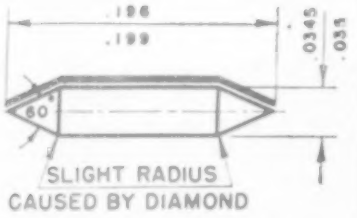
While the essential nature of centerless grinding makes it especially suitable for very long runs and high production of mass items, it is often either necessary or desirable to grind small lots by the same method. There are, in fact, numerous jobbing shops which specialize in short runs of a wide range of pieces on centerless grinders. Some of them keep several machines busy full time, all on small lots ranging from a single piece to a few hundred.

A wide variety of materials can be processed on the centerless: cast iron, steel, aluminum, copper, brass, bronze, enameled iron, plastics, and special alloys of steel and other metals.

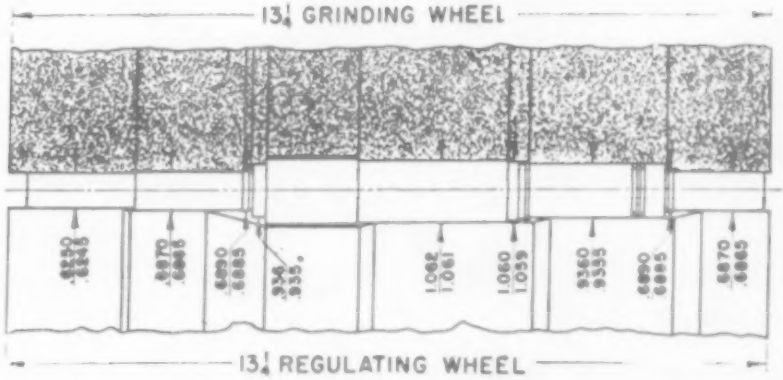
One word of caution for the job-shop operator: changing materials usually involves added downtime, changing the wheel and coolant, and other adjustments including cleaning of the machine and coolant tank.

The secret of doing widely diverse jobs with the centerless is intelligent planning to keep set up time at a minimum. This involves common sense plus a knowledge of the set-up times required for various types of work.

Grouping of similar orders is the key to the whole thing. Where possible, group jobs by type of material first. Then group by thru-feed or infeed jobs because changing from one type of centerless grinding to another usually takes more time than to change from one diameter to another for otherwise similar work. In addition, set-up time is reduced by arranging jobs in order of part diameters so that changes to accommodate different work will be as slight as possible. This procedure should reduce set-up time by



Parts to be centerless ground don't come much smaller than this clock balance shaft which is produced in large quantities by the infeed method. They are automatically fed from two loading magazines, one of which is loaded by the operator, while the other is in the machine.



This armature is centerless ground on 9 diameters with a single 13¼" formed grinding wheel. The operation is automatic, using the infeed method. The limits are .0005" overall on same diameters—.001" on others.

fifty percent from what it would be if no thought were given to grouping parts by diameters.

Comparing Costs

Cincinnati Grinders, Inc., offers the practical shop man this handy formula to help decide whether between-centers or centerless grinding will be more economical for a given job:

Here is a simple formula which, while not absolutely accurate, is at least indicative. Let

M.L.=Value determining whether the work should be ground on the centerless grinder,

A=Set-up time for centerless grinder,

B=Set-up time for center-type grinder plus time required for drilling center holes and an allowance for truing center points,

C=Grinding time for center-type grinding each piece,

D=Grinding time for centerless grinding each piece.

Then

$$M.L. = \frac{A - B}{C - D}$$

If M.L. is less than the quantity in the lot, theoretically the job can be more economically done by centerless grinding. If M.L. is greater than the lot quantity, center-type grinding will be more economical. However, if the difference is slight and if the centerless machine has time available, it may be better to assign the job to the centerless.

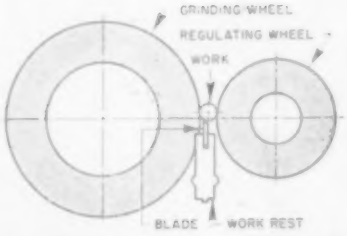
The essential principal is that long runs are by no means the only usefulness of the centerless grinder. The foreman who knows his machines can produce, with inexpensive set-ups, a wide range of small parts on the centerless machine. •

Part 2. Fundamentals and Methods

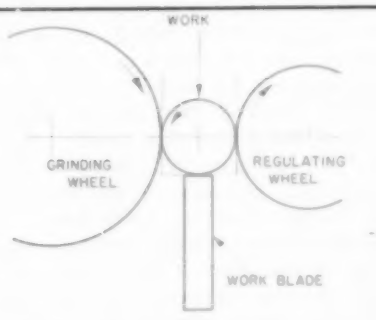
The primary elements of any centerless grinding machine are the grinding wheel, regulating wheel, and work rest. The work rest may incorporate suitable guides for leading the work to the wheels and other guides to lead it away, as well as a blade, or occasionally two blades, to support the work during grinding. These elements may be arranged and combined in a variety of ways, but the principles are the same in all centerless grinding machines.

One who is familiar with cylindrical grinding on a conventional between-centers grinder understands how the work is supported between centers and rotated by a power drive while traversing back and forth across the face of the grinding wheel. This action creates a cylindrical surface, the diameter of the cylinder being governed by the distance from the face of the grinding wheel to a line drawn between the centers of the work.

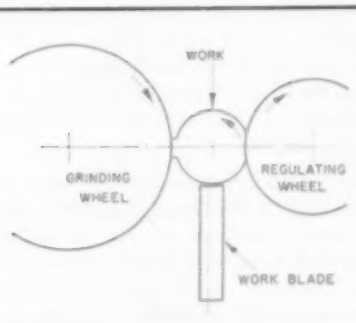
With centerless grinding, however, there are no center points and, to the uninitiated observer, no apparent way of controlling the roundness of the work. The cutting pressure developed by the grinding action forces the work down against the work rest blade and also against the regulating wheel. The regulating wheel, usually made of a rubber bonded abrasive, serves as a friction drive to rotate the work at a constant and uniform surface speed



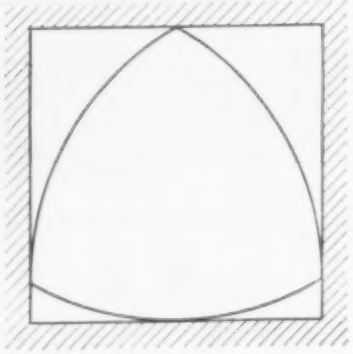
Primary elements of the centerless grinder.



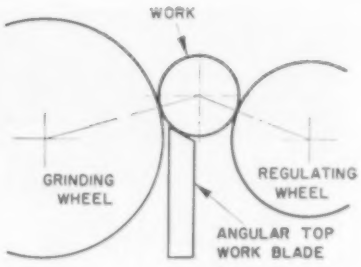
Flat top blade, with work on center.



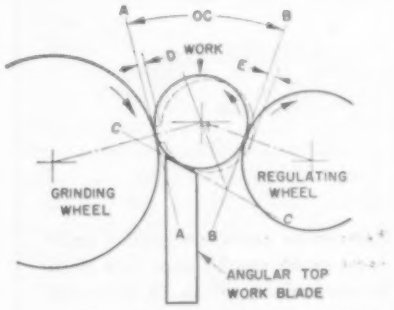
Effect of out-of-round work on flat top blade, and with work on center.



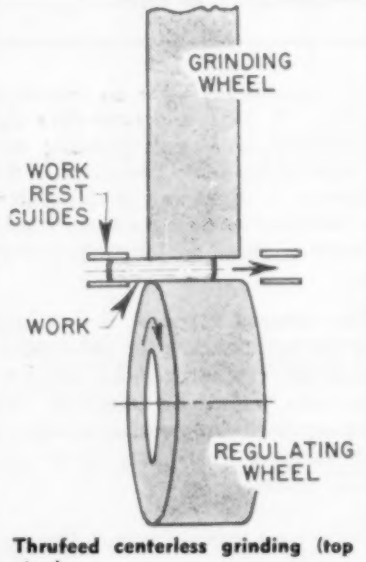
Exaggerated shape generated by above set-up.



Maximum corrective rounding action obtained with this basic set-up.



Diagrammatic sketch of corrective action.



Thrufeed centerless grinding (top view).

approximately equal to that of the regulating wheel. Inasmuch as the regulating wheel rotates very much slower than the grinding wheel, the grinding wheel is enabled to make its cuts on the work.

All centerless machines employ so-called negative work speed. In other words, the rotation of the work and that of the grinding wheel are in different directions. The grinding wheel revolves at a standard speed of approximately 6,000 surface feet per minute. The operating speeds of the regulating wheels may be varied at will to suit the requirements of the work being done, within such speed ranges as from approximately 25 feet to over 900 surface feet per minute.

The ground diameter of the work is determined by the distance between the two active surfaces of the grinding wheel and regulating wheel, but a constant diameter does not necessarily mean a perfect cylinder. Let us examine the factors which make for true roundness.

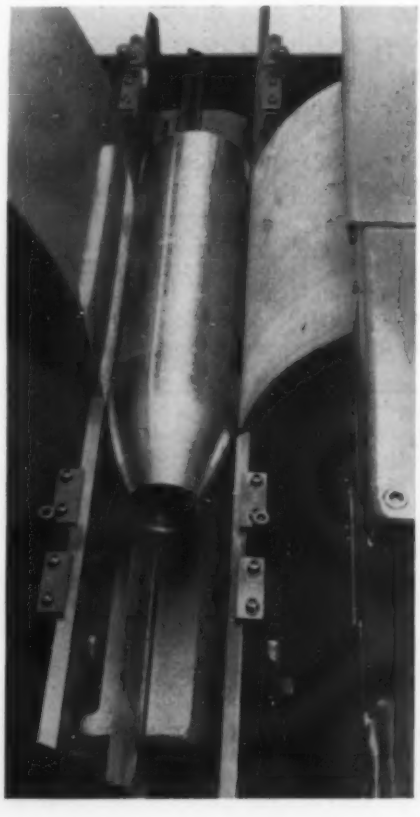
In the simplest instance, the center of the work is in line with the centers of the grinding and regulating wheels. The surfaces of the wheels plus the flat top of the work support form three sides of a square. Thus, any high spot on the surface of the work coming into contact with either grinding or regulating wheel will produce a diametrically opposite low or concave spot. Grinding with this set-up results in work of constant diameter but not cylindrical, the extreme instance of the shape so generated being the three-arc triangle, of constant diameter, but not round.

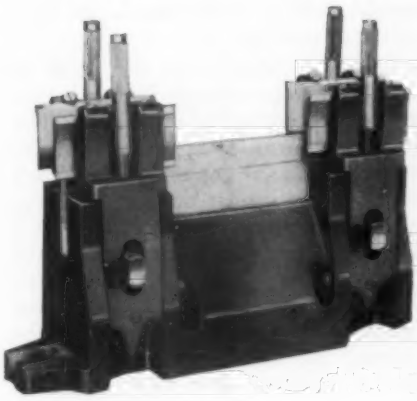
If the center of the work is now elevated slightly above the centers of the wheels by raising the supporting blade, a low spot coming into contact with the regulating wheel will cause a high spot to be generated at the contact with the regulating wheel, but **not diametrically opposite.** As the piece being ground is rotated, the high and low spots will not come opposite each other, and will tend to cancel out, creating a gradual rounding of the piece.

To obtain maximum corrective roundness, use is made of a blade with an angular top. This produces distinct corrective rounding as shown in the accompanying sketch. Two lines, A-A and B-B are drawn tangent at the points of contact of the work with the wheels, and another line, C-C, shows the plane of the angular top of the blade. If a low spot on the work comes in contact with either the blade or the regulating wheel, as in the case of the part shown in dotted lines, the approximate center of the work will be lowered. With centers of both wheels being fixed, the smallest diameter can be generated on their center line. The lowering of the center of the work toward the center line of the wheels causes the reduction in the diameter of the ground piece. Conversely, any increase in height of the center of the work above the center line of the wheels causes generation of a correspondingly larger diameter. Thus the grinding wheel, instead of leaving a high spot on the periphery of the work equal to the depth of the concave spot at the contact with the regulating wheel, generates a proportionally smaller high spot at its contact with the work. In this manner, low and high spots "dampen" themselves out theoretically approaching cylindrical shape in infinity, but in actual practice cylindrical form is obtained in a short time.

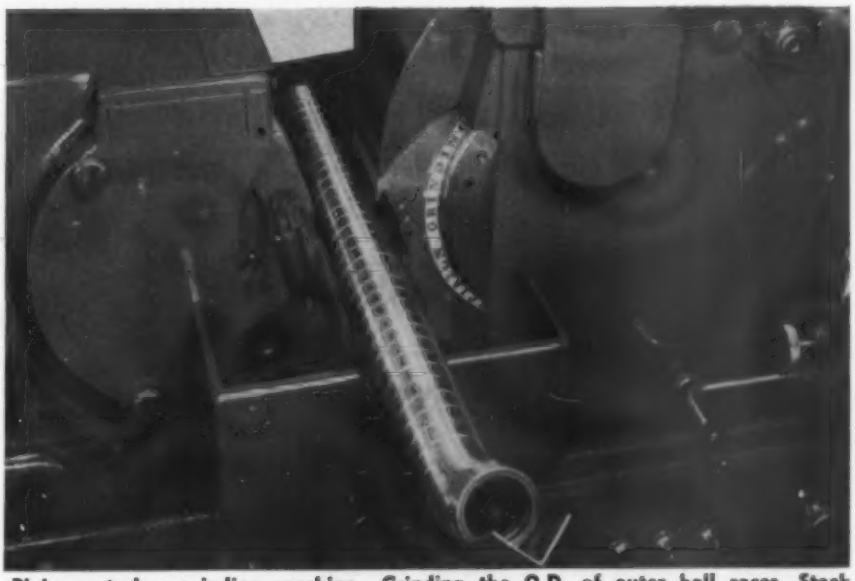
This action depends on many variables, such as the angle of the blade, the size of the work, hardness of the

Thru feed grinding two diameters of a 4.2 mortar. A thru feed type work rest with work support blade is used for this operation. Stock removal is .005-in. from each diameter and production is estimated at 360 work pieces per hour.





Thrufeed work rest.



Plain centerless grinding machine. Grinding the O.D. of outer ball races. Stock removal is .030-in. and production is 4330 races per hour.

metal, speed of regulating wheel, and other factors.

Experience has shown, for example, that if only a light cut is taken, only the high spots will be ground, as from the very first spark the machine tends to generate the largest true cylinder possible to be formed out of the irregular piece being ground.

The higher above center the work is placed, the quicker the rounding action, the limit being reached when the work starts to jump up away from the blade due to the increased vertical components of the forces involved. It is generally possible to go higher with soft wheels than with hard ones, because the decreased contact pressures tend to reduce the tendency to lift the work from the blade. Consequently, grinding a part which is particularly hard to round up, the work can be placed extra high in the machine by using an extra soft grinding wheel.

Other things being equal, work rotating at faster speeds reaches true cylindrical shape faster than work rotating slowly. The upper limit here is when the work chatters from too rapid a rotation. The speed of the work, of course, is changed by changing the speed of the regulating wheel.

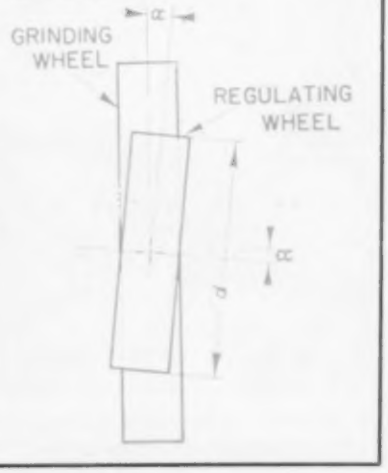
Differing from usual centerless grinding practice, when grinding long work such as long steel rods or tubes, the center line of the work is often placed slightly below the line of the centers of the grinding and regulating wheels. This eliminates whipping or chattering of the bar, as it is firmly held down by the wheels themselves. However, bars should be straight before being ground, as bent or misshapen pieces cannot be straightened successfully in the centerless grinder.

Methods of Centerless Grinding

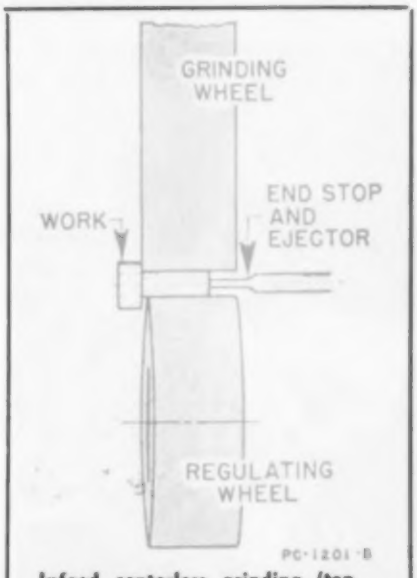
There are four basic methods of centerless grinding: (1) Thru-feed; (2) End-feed; (3) In-feed; and (4) Combination feed. The best method to use for a particular job depends chiefly upon the shape of the piece being ground.

Thrufeed grinding, as its name implies, is done by passing the work between the grinding and regulating wheels, entering the grinding area at one side of the wheels and leaving at the other. Since all points of the work pass all points on the wheels, only straight cylindrical surfaces without interfering shoulders or varying diameters can be worked by this method.

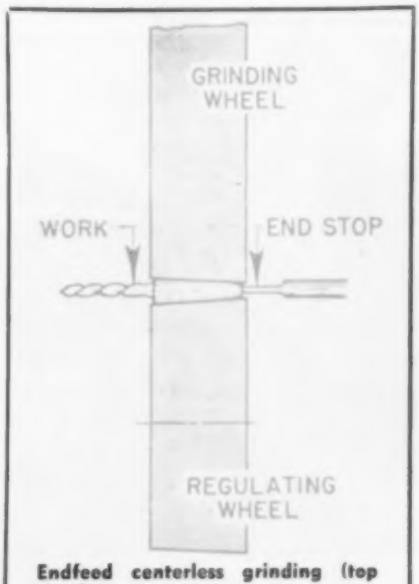
The lateral movement of the piece between the wheels is imparted by the regulating wheel, which is swivelled slightly to an angle in relationship to the grinding wheel. The speed with which the piece moves across the grinding surface of the wheel depends on this angle, together with the speed and diameter of the regulating wheel. This



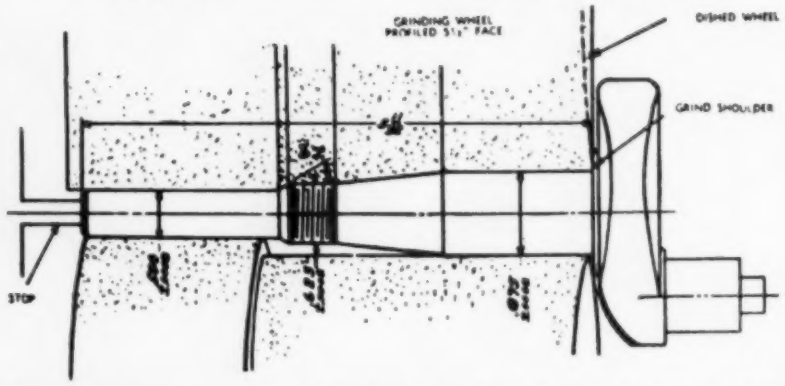
Sketch showing deviation of feed rate formula.



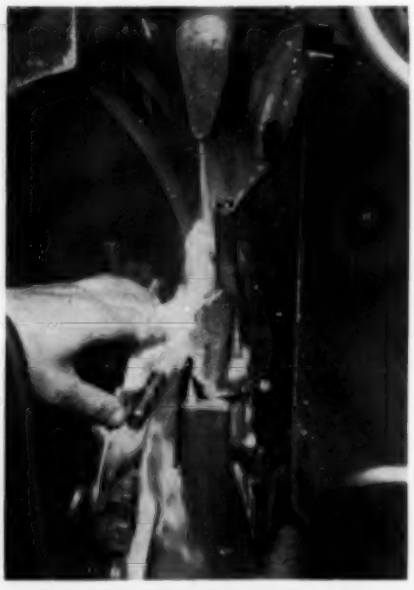
Infeed centerless grinding (top view).



Endfeed centerless grinding (top view).



The diameters are ground by infeed with a slight through feed to the left to enable the dished wheel to grind the shoulder.



Centerless grinding, infeed.

Thrufeed grinding.

traverse speed increases as any of these factors increase.

Based upon the assumption that there is no slippage of the work in contact with the regulating wheel, the formula for calculating traverse speed in inches per minute is:

Multiply pi by the diameter of the regulating wheel in inches, by the speed of the regulating wheel in revolutions per minute by the Sine of the angle of inclination of the regulating wheel from the grinding wheel.

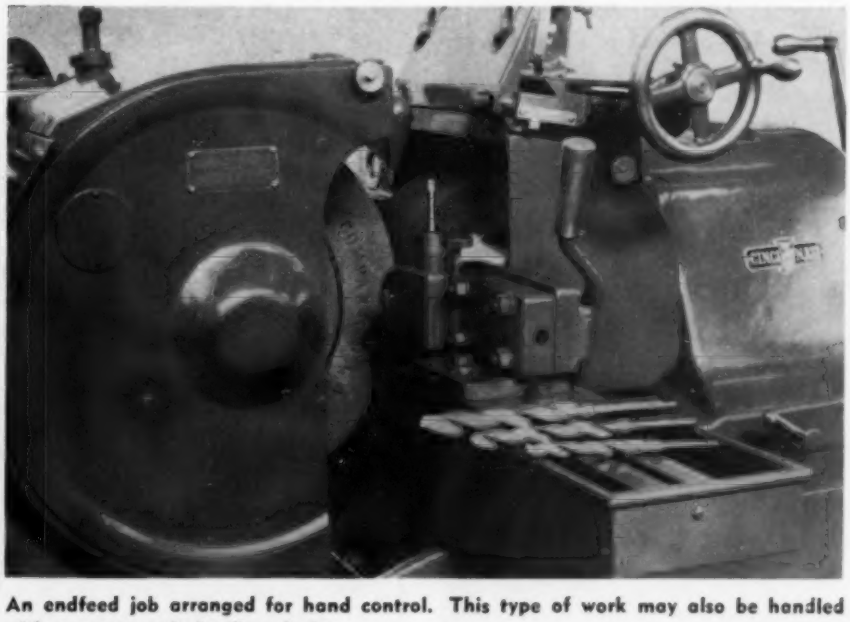
However, the best traverse speed for thrufeed work depends upon such diverse conditions as the physical characteristics of the work material, the amount of stock to be removed, accuracy and surface quality required, type of grinding wheel, diameter of part, weight of part, coolant used, and condition of machine.

It can be seen, then, that with so many variables entering into each run, that tables are really impractical. The practical plan is for each shop to maintain records of all centerless jobs. When a reasonably similar one comes along, the record will at least give a close starting point for determining the proper traverse speed. At the outset, a great deal of time can be saved that might be wasted in experiment by getting the advice of competent abrasive engineers who have had wide experience in applying their wheels to centerless grinding operations.

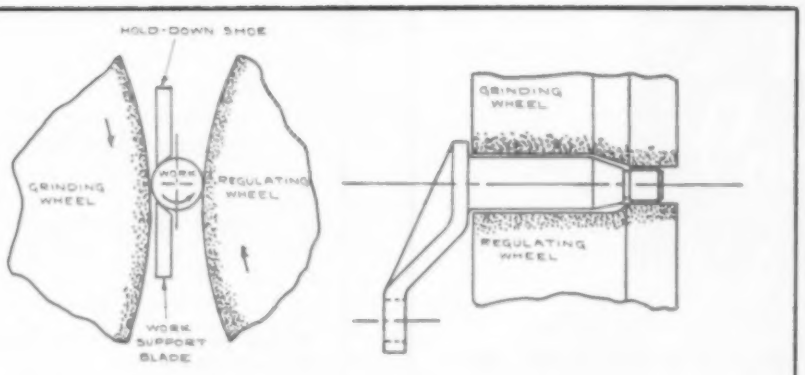
Endfeed grinding is used only on taper work. The grinding wheel, regulating wheel, and blade are set at a fixed relationship to each other, and the work is fed from the front, either manually or mechanically, to a fixed end stop. Either the grinding wheel or the regulating wheel, or both, are ground to the proper taper. The use of end stops, of course, is not limited to endfeed operations, as they are frequently used in infeed set-ups to eliminate undesired movement of the piece while it is being ground.

Infeed grinding, also called **plunge grinding** by some authorities, includes plain infeed grinding, form grinding, grinding out-of-balance work, grinding multiple diameter work, and grinding concentric-ground pieces.

Infeed or plunge grinding is most commonly used on parts which have projections or shoulders, irregular shapes, varying diameters, or other irregularities which would make normal thrufeed operation impossible. It is widely used for multiple wheel or formed wheel grinding of profiles.



An endfeed job arranged for hand control. This type of work may also be handled with an automatic loading device.



Plunge grinding out-of-balance work using hold-down shoe.

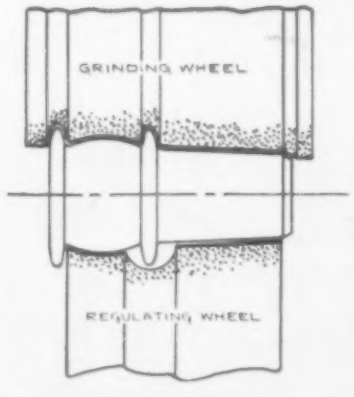
The work is fed to the wheels from above, with no lateral movement of the piece while it is being ground. Thus the regulating wheel is set with the smallest possible swivel—merely enough to keep the work pressed snugly against an end stop.

Formed work, such as balls, special bolts, pivot balls, punches, and many other items must be ground by this method because of their irregularities of surface. The grinding wheel must have sufficient width to cover the entire surface being ground. In most cases the shape desired is cut into the face of the grinding wheel either by diamond truing or by crush truing. Diamond truing is more generally employed, but the crush truing method is being used on many of the more intricate shapes which are difficult to form with a diamond. The regulating wheel is set at a very slight angle to keep the work firmly against the end stop. The face of the regulating wheel is also shaped especially for the job, although it will not conform as exactly to the desired profile as the grinding wheel.

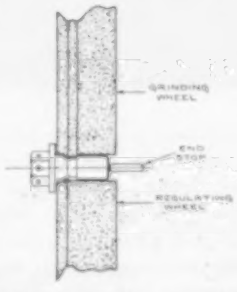
Out-of-balance work is handled in a variety of ways, almost all of which involve some form of work support outside the grinding area. This class of work includes parts with heavy flanges, arms, or eccentrics on one end. Golf club heads, knives, and other odd shapes are included in this group. An overhead hold-down shoe is also a typical part of such an installation to hold the section being ground firmly in place so that both a cylindrical shape and concentricity—if required—may be obtained.

Multiple diameter work which has

Plain centerless grinding machine. Manually operated vertical work loader with work holding fingers, mounted on the regulating wheel head. Machine grinds two diameters and the face surface of a crankshaft simultaneously. Crankshaft lowered between the wheels for the grinding operation. Stock removal is .010-in. from each diameter and .003-in. from the face. Production is estimated at 78 crankshafts per hour.

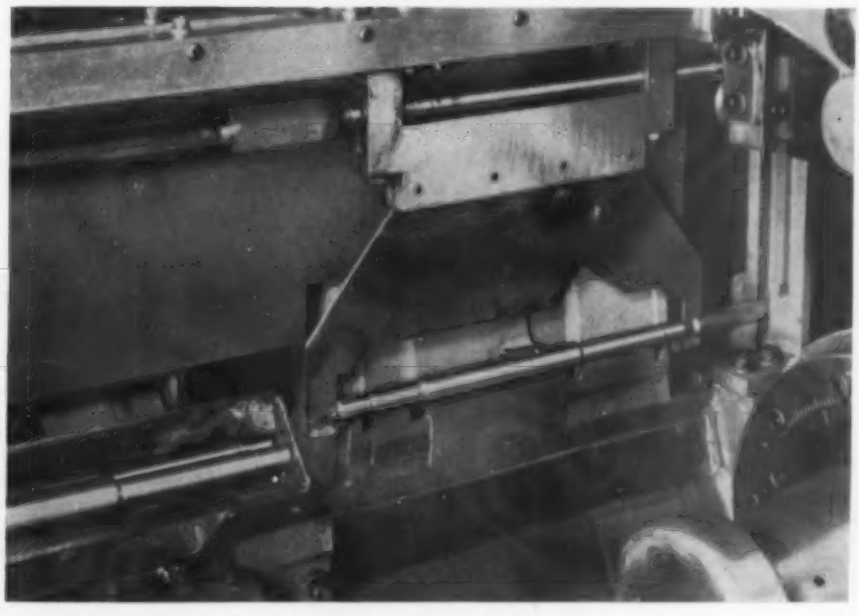


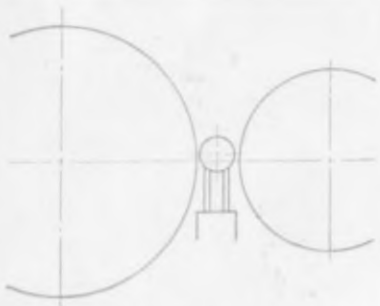
Plunge grinding multiple diameter work. Wheel face formed by crush truing.



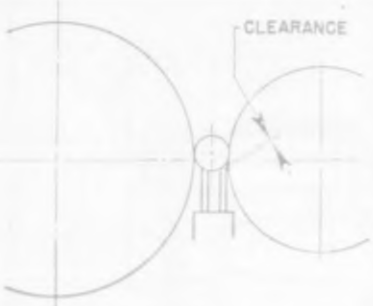
Form grinding. Note use of end stop to prevent lateral movement of work.

Plain centerless grinding machine with automatic hydraulically operated work loader. Rough grinds five diameters of an armature shaft. Stock removal is .010-in. from each diameter and production is estimated at 380 shafts per hour. Workpiece in grinding position. Grinding wheel removed to show operation.

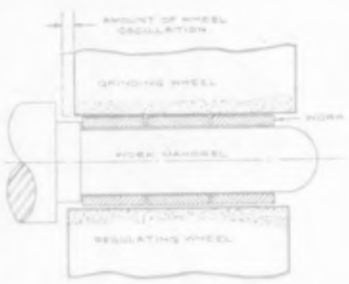




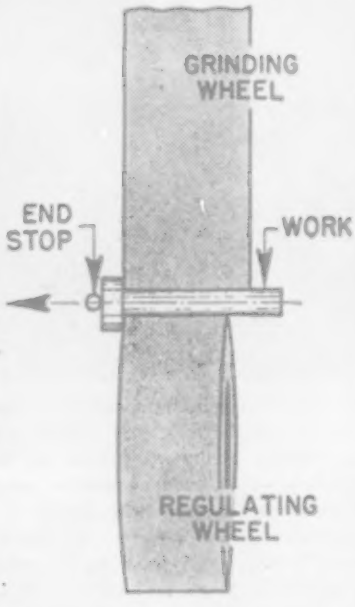
Infeed work, in loading position, supported by two blades.



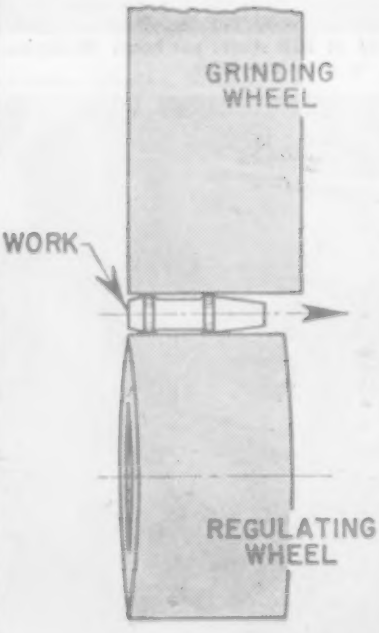
Grinding position of the infeed work.



Plunge grinding the O.D. concentric with the bore.



Combination infeed and thrufeed grinding.



several different diameters all ground simultaneously to close limits is accomplished either with formed wheels or with multiple wheel set-ups. Or in some instances, multiple wheels which are themselves formed to special profiles are used. As in form grinding, wheels may be trued with either the diamond or crush method.

Concentric ground work where close tolerances are required is frequently handled with a special fixture such as a mandrel.

Sometimes large or heavy pieces are required to be handled by the infeed method. In this instance, they are often supported by two work rest blades rather than the conventional single blade. In addition to rotating the work, the regulating wheel lifts it from the blade nearest the regulating wheel and pushes the work against the grinding wheel, where it is ground while resting on only one blade.

Infeed grinding rates are dependent upon several factors, chiefly the nature of the work and operator technique. Solid work which is capable of conducting the heat of grinding away rapidly can be ground at faster infeed rates than light work or thin-walled work in concentric jobs. Similarly, heavy work can be fed faster than light work because it has less tendency to jump, causing chatter or out-of-round conditions.

However, with manual infeed operations, operator technique is by far the most important aspect of production rates. Most operators, when advancing the work into the wheel, can feel the cutting action of the wheel. A newly dressed wheel will cut fast due to the sharp abrasive grains on the wheel face, and the operator can thus feed faster. However, as grinding continues, the cutting grains become dulled, producing a slower cutting action for which the operator must compensate by feeding the work to the wheel more slowly. With automatic feeding arrangements on infeed jobs, automatic and continuous wheel dressing attach-

Plain centerless grinding machine with a cam shaped 16-in. dia. regulating wheel, automatic loader, ejector and complete automatic grinding cycle. Work pieces being ejected after the grinding operation. Machine rough grinds the stem of an automotive cast valve. Stock removal is .020-in. max. and production is estimated at 17 valves per minute.

ments are usually set up so that the wheel remains sharp to a relatively constant degree permitting a uniform quality of surface to be ground to accurately repeated close tolerances.

Combination Infeed and Thrufeed is a frequent answer to centerless grinding problems. There are three principal applications: (1) for parts which are more conveniently ground in one pass but have too great an amount of stock for the more conventional thrufeed method; (2) for grinding the smaller diameter of two-diameter pieces, where the ground portion exceeds the width of the grinding wheel; (3) for handling warped parts where the warpage or bow does not exceed the total stock to be removed and where the length of the part is less than the width of the wheels.

The first classification includes shells of various diameters which require a grinding operation on the bourrelet diameter. These diameters are relatively narrow, and have a stock allowance of about .020". The lower slide is fixed and the infeed motion is obtained through the upper slide, with the remainder of the set-up arranged for thrufeed work. After placing the shell on the workrest blades, the infeed lever is moved down to the positive stop, as in conventional infeed grinding. Meanwhile, the work passes axially between the wheels as in thrufeed grinding. Obviously, the infeed motion must reach the positive stop before the work has reached the exit side of the wheels.

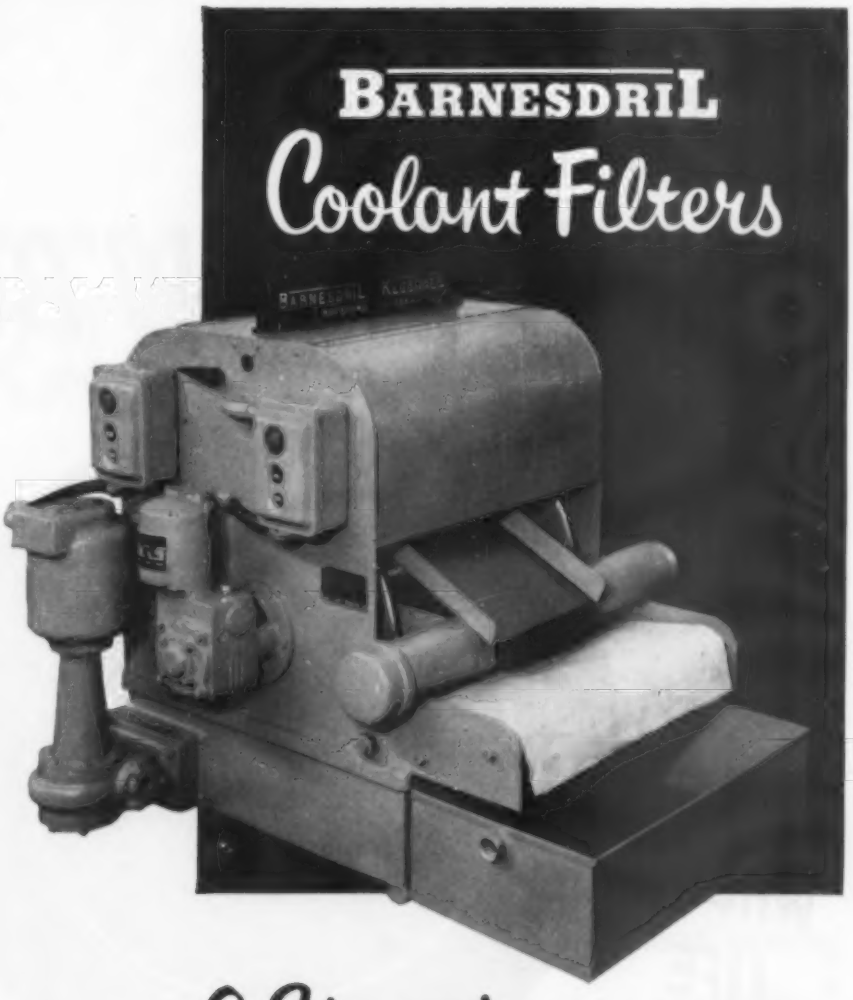
Parts within the second classification (having two diameters, with the length of the smaller diameter greater than the width of the grinding wheel) may be ground with the parts placed on the work rest, as in conventional infeed grinding, but with the end stop at the **front** of the machine. After the infeed movement is completed and the portion of the work between the wheels has been ground to size (slides arranged as in classification 1), the stop is swiveled out of the way and the work traverses through the wheels to the **front** of the machine. The rear-to-front direction of traverse is induced by setting and truing the regulating wheel at a negative angle. This type of set-up should be used only when the work is comparatively short and light, and when a special work rest is available to support the work as it feeds forward.

The third group of parts is mentioned here because they may constitute an important item in shops where a straightening machine is not available. If possible, however, work should always be straight before it is sent to the centerless grinder.

End of part 2. Part 3 will appear in the January issue. • •

BARNESDRIL

Coolant Filters



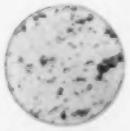
give you 2 Stage*

COOLANT CLEANING

for selective degree of coolant clarity

BarnesdriL Engineers provide two distinct stages in coolant cleaning in the new Kleenall Unit by combining *practical magnetic separation for removal of ferrous particles, with *positive cleaning by filtration to elliminate non-ferrous or other objectionable foreign matter. With the control inherent in this method it is possible to give you the exact degree of coolant cleanliness that is practicable for your production operations. Results up to 99% removal of all coolant wastes are readily accomplished.

Complete Lab Facilities for Your Convenience



Typical microphoto of composite swarf from a high production cutting operation.

In their modern coolant laboratory, these engineers can precisely measure waste particles and classify them by physical types. Percentage of contamination is thus determined, and they are then able to select a filter media and size of unit to give you the degree of coolant clarity you desire.

Why not ask them to analyze your coolant cleaning problems and make recommendations for obtaining the most practical results. Any BarnesdriL representative will gladly supply you with complete details.

write for Catalog 3504

COOLANT BARNESDRIL CLEANING

FILTRATION DIVISION

BARNES DRILL CO.

878 CHESTNUT STREET • ROCKFORD, ILLINOIS

Encircle No. 205 on postpaid card

B7 NEW BOND TYPE

★ **LONGER WHEEL LIFE**

with equal quality of finish

B7 BOND WHEEL

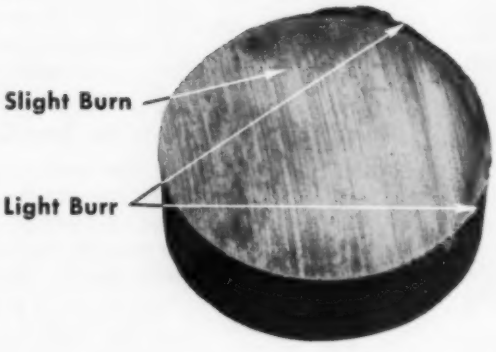
BEFORE CUT-OFF OPERATION

After same number of cuts, B7 outlasts Wheels "A" and "B" by 10-25%.

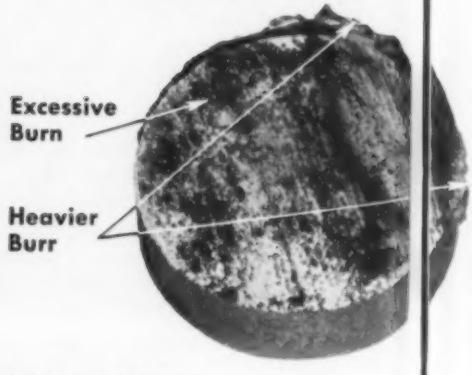
★ **BETTER QUALITY OF FINISH**

with equal wheel life

B7 CUT-OFF



REGULAR CUT-OFF



COLD ROLLED BAR STOCK, 1⅛" DIAMETER

...continually puts more SENSE in your abrasive DOLLAR

SETS NEW STANDARDS OF PERFORMANCE

FOR ABRASIVE CUT-OFF

WHAT ARE YOU LOOKING FOR in your cutting-off operations... freedom from burn and burr?... close tolerance accuracy?... high production?

Here's a revolutionary new bond type—B7—which is the finest combination yet developed to give you maximum work finish, maximum cut-off speed, and maximum wheel life.

Thousands of these new wheels have been job-proven on work just like yours. The B7 Bond Cut-Off Wheel is *another* CARBORUNDUM development. It's a wheel you'll use with profit!

PLUS NEW FEATURES

NEW distinctive wheel marking —for instant recognition

NEW simplified gradings —R, T, V grades only

NEW rough sides are standard— no need to specify RS on order

TRY ONE YOURSELF!

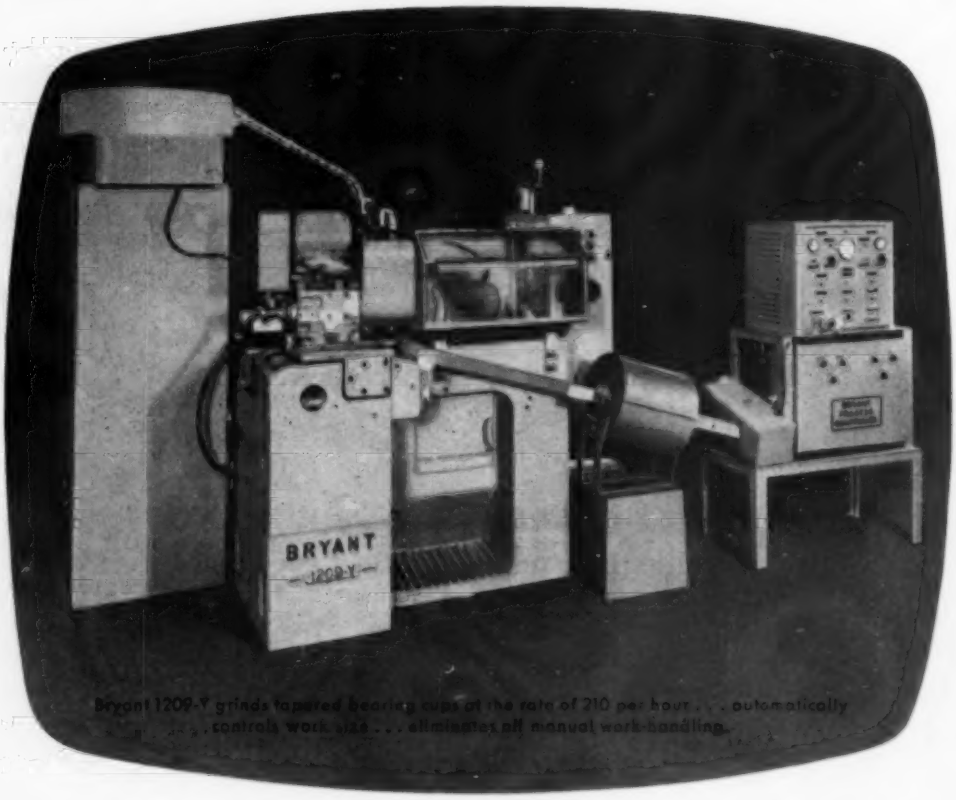
A simple demonstration in your shop, on any material you're cutting, will convince you that B7 Bond Resinoid Cut-Off Wheels will outperform any other wheels you can use. Call your Carborundum Distributor or salesman to arrange a time most convenient to you. He's listed in the yellow pages of your phone book under "Abrasives" or "Grinding Wheels."

CARBORUNDUM

REGISTERED TRADE MARK

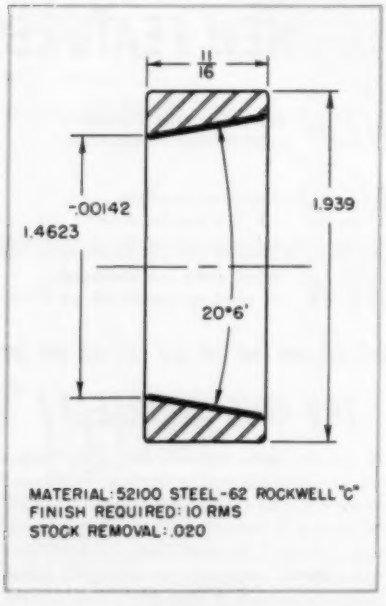
Encircle No. 206 on postpaid card

These extra features



Bryant 1209-Y grinds tapered bearing cups at the rate of 210 per hour . . . automatically . . . controls work size . . . eliminates all manual work handling.

. . . on BRYANT INTERNAL GRINDERS increase output, improve quality, cut costs!



Need volume production? small lot grinding? toolroom versatility? precision? Bryant grinders help you achieve *all four.* In addition, Bryant special equipment and features enable you to attain even broader flexibility and greater precision in your production.

Look into these Bryant cost-cutting features today . . .

- *Bryant Process Controller* — provides automatic statistical quality control.
- *Bryant Air Sizing* — provides automatic size control where extremely close tolerances must be held.
- *Shoe Centerless Grinding* — speeds up loading and unloading of work and eliminates distortion.
- *Automatic Work Handling* — allows integration into automated production lines.
- *New Series 800 Bryant Hi-frequency Wheelheads* — supply smooth, trouble-free operation and plenty of power for the toughest grinding jobs, at speeds from 10,000 to 100,000 R. P. M.
- *Exclusive, adjustable precision alignment features* — maintain original machine accuracy throughout the life of the machine.

Bryant offers three methods of acquisition: 1) outright purchase, 2) conditional sale (short term or long term), 3) lease.

BRYANT

For literature or more information on Bryant machines, special equipment and financing plans, write:

chucking grinder co.

85 CLINTON STREET, SPRINGFIELD, VERMONT

Offices: Indianapolis • Cleveland • Chicago • Detroit • Mt. Vernon, N. Y. • Philadelphia

Internal Grinders • Boring Machines • Internal & External Thread Gages • Granite Surface Plates • Magnetic drum memory devices for computing systems

Encircle No. 207 on postpaid card

Because handling people and working with unions is an important part of today's production management the editors feel that grinding and finishing executives might be interested in these two arbitration cases. While they do not deal specifically with grinding operations the basic thought, or the problems faced in these two case histories, can well be duplicated in any grinding department.

How the Foreman Stands Up In the Arbitration Courtroom

a. Can An Operator Who Refuses a Work Assignment be Fired?

b. How Far Can a Foreman Go In Picking the Best Man For a Job . . . Instead of a Senior Man?

by **Harold R. Nissley,** Consulting Engineer
Cleveland Heights, Ohio

EDITOR'S NOTE: Whether you agree or disagree with the following arbitration decisions we would be pleased to get your reaction. Indeed, if there is sufficient reaction to this article we shall be happy to run a series of such articles (by different authors) on the subject of Arbitration.

AUTHOR'S NOTE: The writer is deeply indebted to his arbitrator friends who have permitted him to use the following case materials. Names and other identifying characteristics have, of course, been changed or withheld; but the facts are substantially as recorded. The writer regrets that he cannot specifically acknowledge the arbitrators and others who have aided in the preparation of this series of cases. The decisions of these arbitrators do not, of course, necessarily coincide with the thinking of the writer or with that of the editor. Differences of opinion may be due to bits of evidence and other factors which the arbitrator had in his possession but which are not recorded here. Because no two cases are identical, the reader is cautioned to read these cases in the light of a particular set of circumstances; a different set of circumstances (even a ten year difference in time) could yield different conclusions or decisions.

Introduction

THERE is a growing feeling among foremen that top management is not backing them up in their efforts to get out more production at lower costs. The fault lies usually with management. But this fault is not due so much to managerial timidity as to management's failure to communicate effectively the pros and cons of arbitration.[1] This article is designed, therefore, to help top management tell its "go-the-limit" attitude to supervisors.

a. Can An Operator Who Refuses a Work Assignment Be Fired?

Issue: Was the Company right in disciplining Smith when he refused to accept work in another department?

Union's Position: This case stems from Grievance 16 written by Jerry Golden and Aleck Smith and dates back to January 12, 1955:

"I refuse to work in the Glass Furnace Room because I have never worked there before and for health reasons."

The Union feels that Smith was justified in refusing work in the Glass Room because of health reasons (he got dizzy[2]) and because the contract gave him the right to refuse such work. On the latter, the Contract has this to say:

"In the event an employee works more than 2 hours on his regular shift before being sent home because of lack of work, he will receive 8 hours' pay. This provision shall not apply in the event that an employee refuses available work which he is physically able to perform or in the event that catastrophies, failures of utilities, or act of a public enemy, interfere with work being provided. . . .

"Vacancies resulting from an employee being off sick, on leave of absence, or on vacation shall be filled by an available, qualified employee in the department and on the shift."

Thus the Company should have filled the Glass Room job within the Glass Room Department—not go outside and bring in someone wholly unfamiliar with the Glass Room operation.

Company's Position: On January 12, 1955 (the same day the grievance was filed) Smith's foreman answered the grievance by stating:

"Aleck Smith refused his work assignment twice last week. He was needed in the Glass Room and was the youngest man on the assembly line. I told him that if he refused future assignments we would fire him."

Because the Union rejected this answer of Smith's foreman, the superintendent, the following day, wrote this answer:

"Management has the right to assign men to work anywhere within the plant and within a man's capacity. As a junior available man on the assembly line, Smith was the logical choice to fill the vacancy in the Glass Room."[3]

The Union rejected the superintendent's reply; so the Manager of Industrial Relations wrote as follows:

"No dismissal action has been taken against Smith up to date. But the Company will be forced to take dismissal action against Smith, if he continues to refuse work assigned to him in other departments on the basis of plant-wide seniority."

Discussion (By Arbiter): In addition to the contractual rights of the parties to the present dispute there are ordinary rules of reason and human understanding that should be given proper consideration. The right of an employer to assign work to operators is not an unlimited right. A painting contractor cannot, for example, order regular house painters to paint a 75 foot mast on top of a 500 foot building; even steeple jack painters could refuse such an assignment—if there was a 40 mile wind blowing and/or the temperature was around freezing.

Neither is the right of the individual unlimited in trying to protect his physical and mental health against ordinary demands made on him by his employer.

The Union affirms the contract gives its members the right to turn down work outside the department or craft of a member. They quote Article III and Article IX as the bases for these rights.

The Arbitrator, however, cannot agree with the Union's interpretation of these articles in the present case. What would happen, if the Union's view prevailed and spread all over the plant? On warm summer days whenever the Glass Room needed additional man-power it would be difficult, if not impossible, to get men to run the furnaces. Failure to operate the furnaces would result in no glass parts for the other departments. With production at a standstill, how long would the work force continue to draw pay checks—or the Company to stay in business.

Award: Because of the difficulty of operating a plant without reasonable control over work assignments, the Arbiter must sustain the Company's right to warning notices when reasonable work assignments are refused. Operators, of course, may escape such warning notices by performing questionable work assignments and entering grievances against such assignments.

The Arbiter, however, does not endorse dismissal action in the present case as the first penalty. Rather he recommends a three step disciplinary procedure: (1) Written warning; (2) two- to five-day furlough; and (3) third offense, dismissal. Despite the fact this was Smith's third refusal to perform Glass Room work, the Arbiter believes the second disciplinary step above should precede the severe penalty of dismissal.

Relief, therefore, is granted to the Company in its right to make reasonable work assignments anywhere within the plant (within the framework of the Contract)—and to impose gradually progressive

---

[1]There are, of course, other ways of settling disputes besides arbitration—including the strike or the lockout. Arbitration and these other techniques are discussed by the writer in a series of articles in the MACHINE AND TOOL BLUE BOOK, also a Hitchcock Publication, January, 1955 ("Arbitrating Work Standards"); April 1955 ("Arbitrating Work Standards—Cases"); June, 1955 ("Selecting the Arbiter; Costs of Arbitration: Results of Arbitration"). These and other articles have been published in booklet form and are available at $1 a copy.

[2]The Company introduced a photostatic copy of Smith's medical report showing where he answered "No" to the question, "Do you ever have spells of fainting or dizziness?"

[3]The Glass Room job paid 12c an hour more than the assembly line job; so there was no question of pay involved.

penalities for refusal to accept such work assignments.[4]

b. How Far Can a Foreman Go in Picking the Best Man for a Job—Instead of a Senior Man?

Issue: Did the Company violate the 1955 contract when it refused Steve Jensen the right to bump Robert Warner?

Grievance Statement: "I protest my layoff while the Company retained a younger man," a Steve Jensen, May 18, 1955.

Background and Facts: The grievant, Steve Jensen, was hired in June of 1953. In July, 1953, the Company hired Robert Warner. Both men were hired in as machinists and received an initial pay of $1.75 an hour.

Because of Warner's aptitude and interest in tool making—plus the Company's need for a toolmaker, —the Company sent Warner to school (nights—paying for his tuition). At the end of two years Warner was classified as a toolmaker and was making $2.75 an hour compared with Jensen's rate of $2.25 an hour.

The Company had the highest of praise for Warner's ingenuity and general value to the Company. Put the Company considered Jensen "just an average machinist."

When a layoff occurred in Jensen's department, Jensen (on the basis of seniority) asked for Warner's job. The Company refused on the basis that seniority applied only on jobs that could easily be learned and performed by bumpers.

The contract had this to say about the matter: "After a 5 day layoff, senior employees may replace junior employees (in other departments) providing the senior operator is capable of performing the work of the junior operator—after the senior operator has received the normal amount of instruction given to other qualified operators performing the work."

The Union pointed out (and the Company did not deny) that Jensen had put in a few hours as a toolmaker on one occasion(when the Company had a rush job). On that occasion Jensen was paid the toolmaker's rate. But the Company insisted this was an emergency job (which the Union did not deny).

The Company's main position is that it cannot go through a tremendous training program everytime men are laid off or shifted. The Company stated further that it always lived up to the seniority clause in the contract—within the intent and meaning of the clause. But the two-year training of a machinist to become a toolmaker was outside the reasonable meaning of this seniority clause.

Discussion (By Arbiter): Apparently Warner was both capable and qualified. Using the academic scale of rating, could it be that Warner was an "A" toolmaker and Jensen merely a "C" man? The foreman's enthusiasm for Warner would seem to point to his superior qualities as a worker. Indeed, would it be fair to say the Company recognized they had in Warner an unusual man and was, therefore, loath to lose him in favor of an average man? The Arbiter is not answering this question; he is pointing out a possibility—indeed a probability.

There are few among us who welcome changes in a smooth-running operation. There are few who like to train new people on jobs when present personnel are doing satisfactory work (in this case, superior work). And when bumpers approach their rights with belligerency (as in the present case), Company resistance to replacement becomes ever greater.

But is not part of the job of management that of training new people for new jobs? Indeed, do not large and progressive firms deliberately change people around. when they can, to give them broader experience so that death and other personal catastrophies do not result in great loss in efficiency (and for other reasons)?

It is true, of course, that there is a limit beyond which a Company cannot go in training people for other jobs. A floor sweeper, for example, could not expect a Company to train him to become a design engineer. A typist could not expect her employer to train her to become a job estimator despite the fact that some of the same skills and equipment may be used in both occupations. Anyone can see the absurdity to bumping or upgrading in these extreme cases.

Not so obvious are the differences between the job requirements of a machinist and a toolmaker. Both must read blue prints (in many cases the same prints). Both must handle the same parts and must integrate these parts mentally and physically. Both require imagination. Differences between these two jobs are differences of degree rather than of kind.

However, there is no question but what a superior man is required in toolmaking compared with the man who sets up jobs, repairs equipment, and machine parts to close tolerances. Warner had demonstrated his ability to fulfill the job requirements of toolmaker to the maximum degree—after some training on the part of the Company (and initiative on Warner's part).

Although it is doubtful whether Jensen could ever do as good a job of toolmaking as Warner has done, does it necessarily follow that Jensen would not do an acceptable ("C") job, if given the same amount of training that Warner received? An absolute answer to this question would have to await the results of (a) verified aptitude tests, (b) a trial period on the job, and/or (c) other measures of job success.

[4]This award was made by an industrial engineer with five years of arbitration experience to his credit.

Award: Because Jensen did not have the opportunity of demonstrating either his toolmaking aptitude (during a reasonable trial period); because Jensen did have some previous, albeit limited, experience in toolmaking; because training new and re-training old operators is a proper function of management (usually the foreman)—within reason; because Jensen's qualifications for toolmaking were compared with those of a superior toolmaker—not an average toolmaker; because Jensen had earned two merit raises during his two-year service with the Company; for these and other reasons the Arbiter rules the Company violated the 1955 agreement when it refused to permit Jensen to bump Warner in the latter's toolmaking job.

The Arbiter, therefore, recommends that Jensen be given a 10 week trial period (with proper instruction) to demonstrate his on-the-job aptitude for eventually attaining the necessary knowledge and skill of a toolmaker. As a substitute and upon mutual agreement, other equally acceptable work to Jensen may be offered by the Company.

The Arbiter further recommends that Jensen be paid retroactive pay from the time he was laid off up to the time he is called back to work—minus any earned income and/or unemployment compensation received during his furlough. ● ●

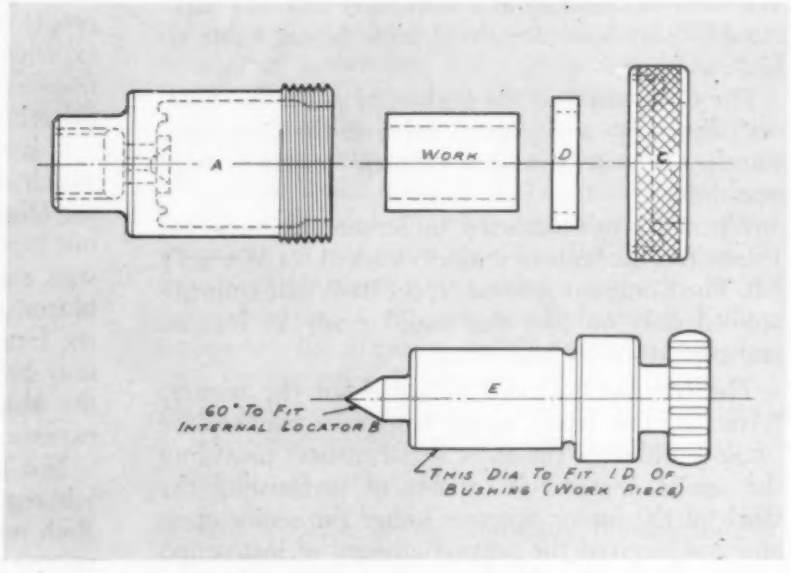
[4]This award was made by an industrial engineer with five years of arbitration experience to his credit.

Precision Bushing Chuck for Grinder

By **H. J. Gerber**

SHOP HINTS and KINKS

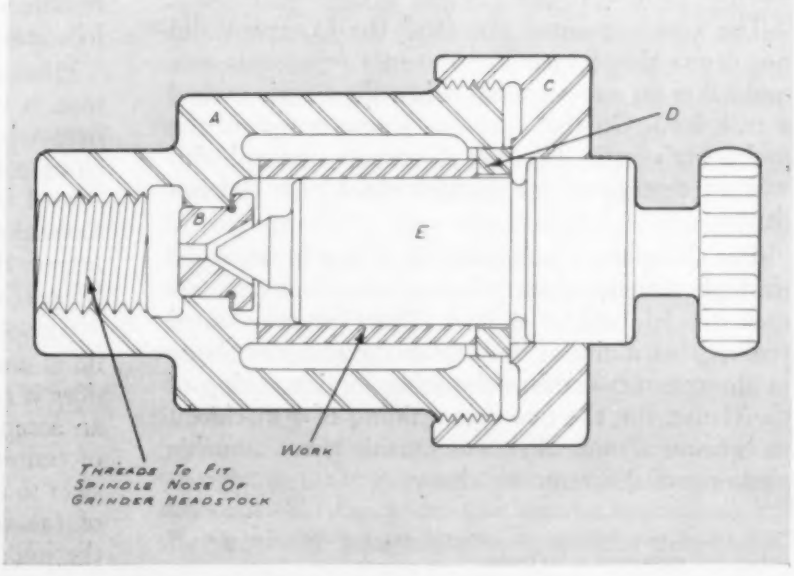
THE internal grinding of thin wall, high precision bushings often presents problems in the holding of the bushing without distorting it and at the same time providing a method for alignment of the existing bore to very close limits of concentricity. A chuck is often out of the question due to the forces exerted by the jaws in gripping the work. A collet may not be the answer either, possibly because the bushing is beyond the collet range of the machine or because the O.D.'s of the bushings vary in diameter or are not of a standard collet diameter. The illustrated bushing chuck has proven to be successful in holding a bushing by end pressure only. This method of holding will absolutely prevent distortion and consequent out of roundness of the finished workpiece. The accompanying setting plug **E** permits the bushing to be aligned to very close concentricity limits with the existing bore of the bushing.



The body of the chuck **A** is machined to thread onto the spindle nose of the grinder. A hardened steel female centering plug **B** is press fitted into the inside end of the chuck. This centering plug has a large 60 degree center hole ground into it. The center hole acts as a locator for the conical end of the setting plug **E.**

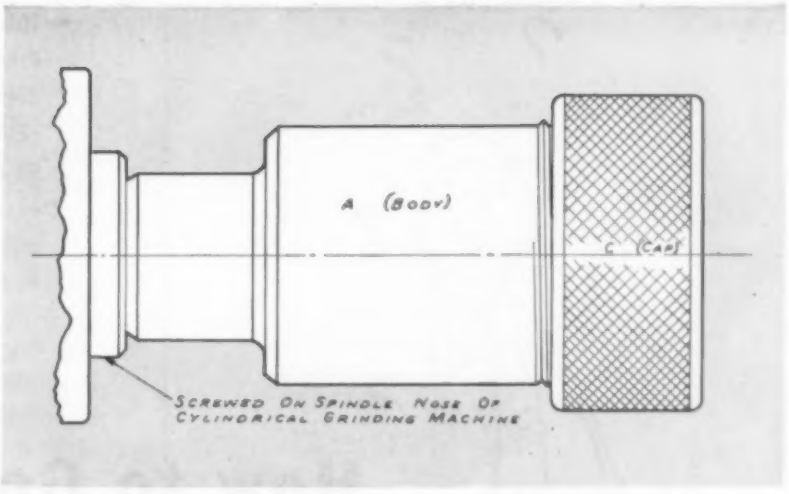
A piece of work is set up in this chuck by the following procedure: The workpiece is inserted into the cavity of the body **A.** The hardened and face ground ring **D** is slipped in against the end of the workpiece and the threaded cap **C,** into which the gaging plug **E** is snugly fitted, is screwed onto body **A.**

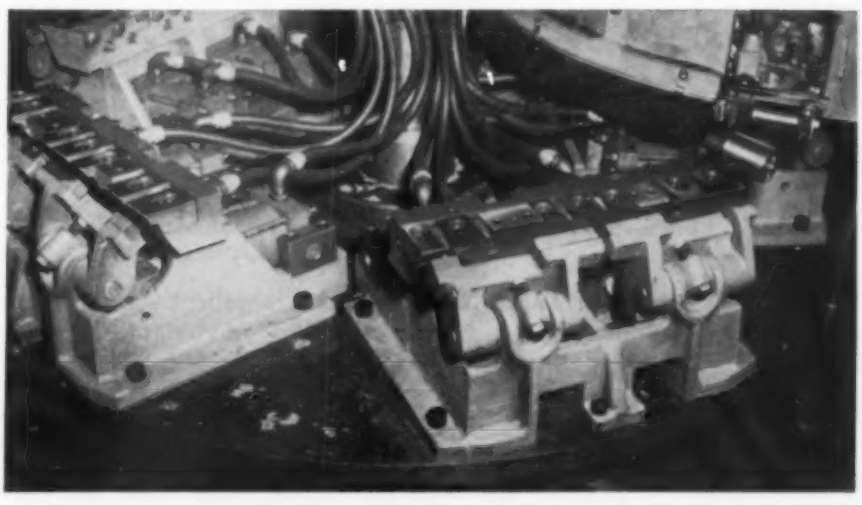
When the gaging plug **E** is pushed tightly into place it will seat in locator **B** and its large end will be guided on true center by the precision inside



bore of the cap **C**. Cap **C** is now tightened firmly by hand and the setting plug **E** is wrung out of the assembly and set aside for use on the next workpiece. Grinding of the bushing bore can now proceed.

Care must be taken in the building of this chuck. The threads on the body and cap must be concentric and fitted fairly snug. These threads must be absolutely clean if the cap is to screw on concentric and properly guide the setting plug on true center. It is good practice to finish grind all internal seating surfaces of this chuck while it is assembled upon the machine on which it is to be used. • •





As shown, the fixture consists of a square piece of ground flat stock with T slots milled into it to hold keys into which are inserted various lengths of pointed end bolts through a tapped bolt hole.

This device holds the piece in much the same manner as the planer holds its machinable items. • •

Vertical Grinder Speeds Plow Share Output

High production rates have been achieved by one farm equipment manufacturer in grinding replaceable plow shares through the use of a Besly-Welles No. 953-35-in. vertical grinder. A maximum of ¼-in. of stock is removed from each share at a rate of between 350 and 400 steel shares per hour by the grinder.

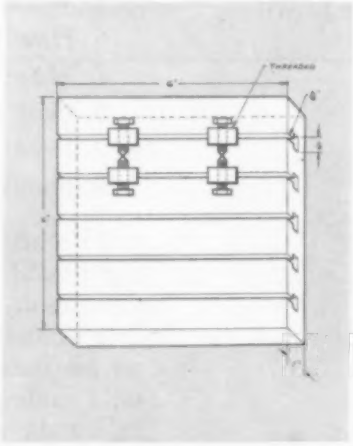
Adapted for automatic operation, the grinder is equipped with five automatic clamping fixtures which can accommodate 12-in., 14-in., 16-in. and 18-in. plow shares. The fixtures are mounted on a rotary table which automatically revolves beneath the abrasive disc of the grinder. As a further automatic feature, the grinder is equipped with a mechanism to compensate for abrasive wear. This adjustment can also be made manually.

Duties of the single operator are limited to loading and unloading the clamping fixtures.

Powered by a 100 h.p. motor, this grinder is recommended for finishing parts that require close accuracy coupled with high production.

Surface Grind Non-Magnetic Materials

To solve the problem of surface grinding non-magnetic materials, especially in smaller sizes, Gilbert P. Sentz, a mechanic in Allis-Chalmers Research Laboratories, devised a fixture for holding the material parallel to the grinder.



At last, a top quality industrial sander that provides all the most wanted features — yet sells for so little.

complete with cord, plug, switch ready to use **$89.95**

Illustrated Literature on Request

A few desirable distributor territories still available.

WALLS SALES CORPORATION
333 Nassau Avenue Brooklyn 22, N. Y.

Encircle No. 208 on postpaid card

This is the fourth part of a five part series on Precision Barrel Finishing. The first part, September, dealt with Limitations and Applications; the second part, October, discussed Equipment; the third part, November, discussed Types and Use of Media and Compounds. The concluding part, 5, will appear in January.

How to Get Best Results With Precision Barrel Finishing

Part 4: Outline of Methods and Hints to Operators

In This Part the Authors Discuss:

- ✓ selection of media
- ✓ influence of size
- ✓ estimating the work load
- ✓ loading the barrel
- ✓ influence of water level
- ✓ choosing the compound
- ✓ choice of speed
- ✓ determining cycle length
- ✓ rinsing the barrel
- ✓ burnishing the parts
- ✓ bright dipping and ball burnishing
- ✓ dumping and unloading
- ✓ rust protection
- ✓ media storage
- ✓ reconditioning the steel media

By **Morris S. Shipley,** President
and
William A. Biebel, Vice President
The Esbec Barrel Finishing Corp.
(Formerly Tumbling Sales & Service Co.)
Byram, Conn.

• THERE have been some excellent stands taken by barrel finishing operators and engineers as to whether barrel finishing is an art or a science. The purpose of part 4 is not to resolve this question, but to discuss the variables involved and some of the means to control them. When enough experience has been gained on a particular job, this one job can be reduced to a science, but the next job may present a problem that can be solved only by cut and try methods backed up by some educated guessing. When faced with a part to be barrel finished for the first time, the person responsible must decide:

1. What media shall be used (type and size)?
2. How many parts can be safely loaded for the most economical load?
3. How shall the parts be loaded?
4. What water level shall be used?
5. What compound shall be used?
6. How fast shall the barrel be rotated?
7. How long should the barrel be rotated?
8. How should the part be burnished?
9. How should the barrel be dumped?
10. Should the parts be dried or oiled?

With all of these questions and with each offering several good answers, the person making the decision must have a sort of sixth sense or he may find himself with a barrel load of scrap or rework on his hands. A tool setter setting up a new job on a milling machine can work with a few pieces to test the setup and at the same time observe the

operation, but while the barrel finishing setup man can try one or two pieces in a laboratory size barrel, he can ascertain only the type and size media and the compound to be used. His major questions such as number of parts to be loaded and speed of barrel cannot positively be answered until a production run has been made.

For maximum economy, as many parts as possible should be finished at one time, but too many parts will result in nicking, scratching, peening of burrs, tangling or bending, all at considerable salvage expense. An advantage of barrel finishing is the uniformity of results, but we should not forget that those results can be uniformly bad as well as good. Some of the technique involved on new problems may be art, but part of it can be reduced to a science with the major part of the education coming from a combination of past experience and testing on the problem parts. The following is a discussion of some principles involved in making the decision for testing.

Selection of Media

There are many types and sizes of media available, as discussed in part 3 of this series, all of which have their advantage for some particular problem. By judicious use of compounds and varying techniques, several types of media can be used in solving a particular problem, but usually the shape and size of a part as well as the material from which it is made narrows down the selection of media to one or two choices.

First to be considered is the method of separation after the parts have been tumbled. If the parts are quite large, they can be screened out of any media and there is no problem of separation. If the parts are ferrous, they can be separated magnetically from any non-ferrous media and if the problem is one of stock removal, they can probably be best finished in one of the abrasive chips.

If the total barrel capacity is one cubic foot or less, usually a self-releasing hand magnet can be economically used. If the loads are larger, the fully automatic magnetic separators provide the most efficient and most economical means of separation

Media should be selected with great care; each requires its own technique for highest efficiency. Usually the shape and size of a part as well as the material from which it is made narrows down the selection of media to one or two choices.

since the load can be separated while the operator is attending to other duties. The use of magnetic separation also permits the most efficient size chip to be used and not one selected in order to permit screen separation. Of course, chip sizes that will wedge in the parts cannot be used.

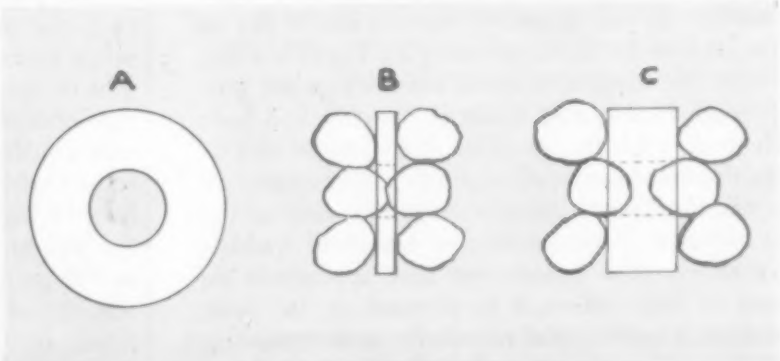
If the parts are non-ferrous and must be screened out, the chip must be either larger or smaller (generally smaller than the part) to permit screening. Aside from the screening problem, the size depends upon three other factors—the wedging problem, the amount of stock or burrs to be removed, and the finish required.

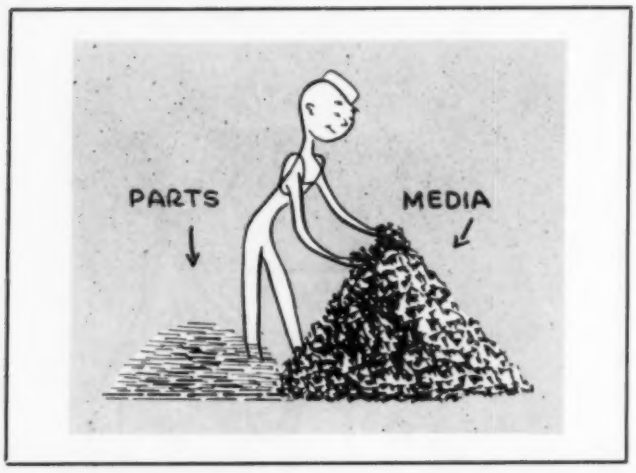
Wedging can be very troublesome and very expensive at times, especially on intricate parts offer-

Conditions which invite wedging: If part A has a thickness as shown in figure B, almost any size of chip can be used without wedging because the chips on opposite sides of the part block each other from wedging.

If part A has a thickness as shown in figure C, chips of about the same size will lodge solidly in the hole. This would prevent any further action at the hole and later must be pounded out of the hole by hand.

This illustrates that other conditions aside from the mere size of hole or slot must be considered in selecting chip size.





The important consideration in determining the proportion of parts to media is volume, not weight. One good rule of thumb is: use one part of parts to three parts of media.

ing many different sizes of holes, slots and crevices. If it is impossible to choose the chip size that will not wedge in some place or other, it may be wise to go to the controlled size media such as steel or zinc shapes in combination with abrasive compounds. If this is impractical, holes in slots often can be masked with wood, foam rubber, wax, etc. before processing, which is less expensive than removing wedged media after the operation, especially where blind holes are encountered.

One thing sometimes overlooked is that on relatively thin parts, wedging will not occur in a hole or slot if the hole or slot is wide enough and the part thin enough to permit the potential wedging size to bear against the media on the other side of the part. This is illustrated by the sketch accompanying.

After certain sizes and types of media have been eliminated by consideration of wedging and separation problems, the selection is narrowed down to one or two types and a given number of sizes. Now it is relatively simple to decide upon the best size from the sizes not eliminated.

Influence of Size

The problem may be to remove burrs and/or break sharp edges. Along with this the engineer must also concern himself with the surface and final color requirements of the parts. Here is where knowledge of the action of the various types as well as sizes of media comes into play. For deburring and edge breaking, aluminum oxide chips are generally used. However, the size of the chip will have much to do with the speed of operation as well as the final surface finish. A large size aluminum oxide chip will cut faster than a smaller size chip of the same material, but the smaller size will yield a better finish. The reason for this appears to be because of the difference in pressure at the point of contact. The weight of the media in the tumbling barrel is distributed among the individual chips and consequently the larger the chip size, the fewer chips and the greater amount of pressure per chip. For illustration, the reader should ask himself whether he would rather have a one hundred pound boulder or one hundred pounds of sand trapping his hand against the ground. If he were to snatch his hand out from under either of these loads, which would remove the greater amount of skin? This apparently is what happens in the tumbling barrel. A combination of abrasive and weight plus a difference in relative speed between the parts and media result in removal of metal. Since a large chip has the greater pressure and is removing more metal at the point of contact, it can never yield as fine a finish as the smaller chip.

While a difference in physical characteristics of the various types of chips will provide different surface finishes, a size difference of a particular type chip will do the same thing, ie. a No. 2 natural chip will yield a better finish than a No. 2 aluminum oxide chip. A No. 4 aluminum oxide chip will also yield a better finish than a No. 2 aluminum oxide chip.

Changes in speed of cut or degree of surface finish can be made by adjustments of other variables as covered further in this part; however, the influence of the chip size will still hold true with the adjustment.

Estimating the Work Load

Consideration of the speed of cut and finish required has helped choose the size of the media. The next problem is the proportion of parts to media. The important consideration here is volume, not weight. A ball shaped part is the most symmetrical and, therefore, can be loaded in a greater ratio to chip volume than can any other shape part. In fact, these parts often can be run as a part on part job (no media). However, while ball shape parts are in the minority of those being barrel finished, the rule still holds true that the more symmetrical the part, the greater can be the ratio of parts to media. This is subject, however, to the exceptions presented by unusually large and heavy parts which will cause impinging marks or peened over burrs as a result of striking each other.

The problem of ratio of parts to media involves only the maximum number of parts. At one time when barrel finishing was confined to part on part jobs or sand rolling, most of the weight of the mass was obtained from the parts themselves and there was a difference in speed of cut or even maximum results which varied with difference in volume and hence weight. When a medium is used, it provides the weight and one part can be processed as quickly as 500 parts with a given chip load, as long as the number of parts does not become high enough to result in tangling or impingement by the parts themselves. The weight of the media is necessary

for optimum results only up to a certain point, however. Beyond this point, adding more weight contributes very little extra benefit for efficient results. Other variables can contribute much more to the speed of the cycle.

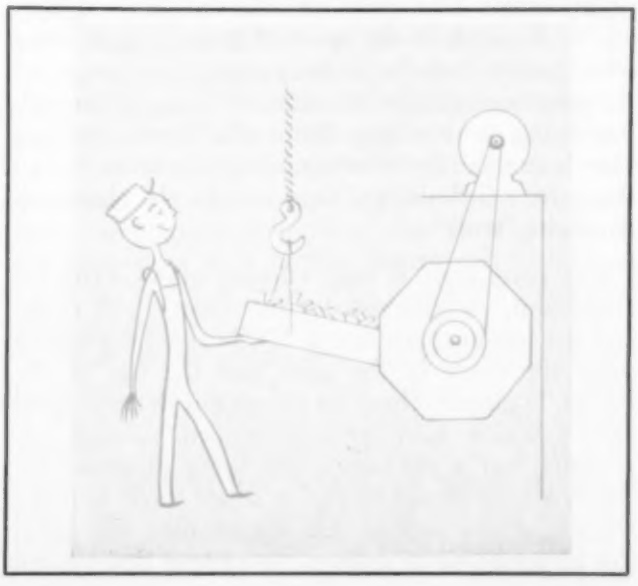
The rule of thumb generally used to load average parts is a ratio of one part of parts to three parts of media, all by volume. Parts that have a tendency to tangle, bend or nest in the barrel must be loaded in a lower ratio, sometimes as low as one part of parts to ten parts of media. On the other hand, many small, nearly symmetrical parts can be loaded in a one to one ratio. Large complicated parts can be racked or run singly in a special size compartment.

Loading the Barrel

After deciding upon the ratio of parts to media through advice or experimentation, the parts are ready to be loaded. One thing to be remembered at this point is that with a particular chip and compound, the speed of cut depends more upon the load height of the mass within the barrel than any other factor. For production and economy reasons, a barrel is usually loaded at least 50% full. As the mass load is raised beyond 50%, the speed of cut diminishes but the action is more gentle. On delicate parts, therefore, higher mass heights are often used. In a great many instances, although the speed of cut is slower at a higher load level, more parts can be run simultaneously and consequently the unit cost per piece is lower. Barrel running time is relatively cheap. The most significant barrel finishing cost is the man time for loading, rinsing, dumping and separating.

If a part requires a six or seven hour cut and the barrel finishing department is operating one shift, it can often be worked out to run a batch of parts at a 50% level in the daytime and then a larger batch run at a higher chip level and/or a slower speed during the night (16 hours) with identical work being performed. This naturally takes fuller advantage of the tumbling equipment. If this cannot be worked out, a second load can be run at night with timing devices either to shut off the barrel during the night or with a delayed start timer to start the machine at a given hour during the night and have the machine continue to run until the operator reports for work in the morning.

In loading the barrel, remember: with a particular chip and compound the speed of cut depends more upon the load height of the mass within the barrel than on any other factor.



For the water level in a barrel a good starting point is: level with the mass. Lowering the water level will increase the cutting action of the media and raising the water level will reduce it.

When the work load has been decided upon, the operator has a choice of loading the parts in the hoist pan with his media, dumping the parts in the barrel simultaneously with the media, or loading the barrel layer upon layer.

Loading the work in the hoist pan with the media and mixing both in the hoist pan with a hoe or some similar device is the most practical way for average parts. A fairly good dispersion of parts within the media to start with is recommended to avoid bending. If the parts are loaded in the barrel on top of the media, the first revolution will dump the entire mass of media on top of the work and if this work is subject to bending, will have that result immediately.

Fussy work, which includes parts subject to tangling, bending, or impinging, should be loaded layer upon layer which means depositing a bed of media in the barrel, then spreading a layer of parts upon this, then adding a layer of media, etc. This method, although somewhat more time-consuming, is worth while because often it is the key to the successful

barrel finishing of a part. When large barrels are being loaded by a layer upon layer method, many operators, to reduce the loading time, suspend the media and parts at the barrel opening by means of a hoist and actually climb on the barrel itself or on a step ladder where they then rake in media, scatter some parts, rake in more media, then parts, etc.

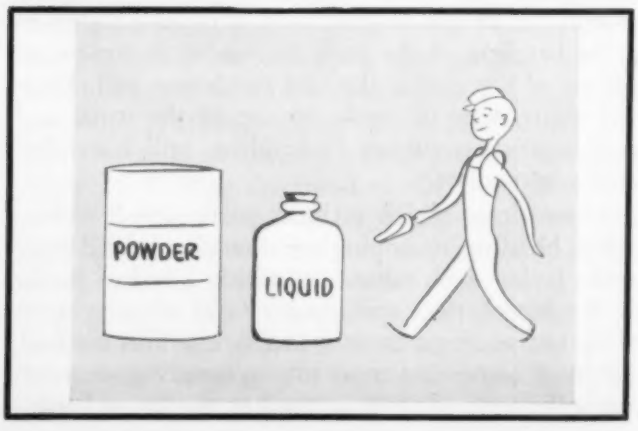
Influence of Water Level

After loading the parts and media, the two remaining items to be added are water and compound, both of which require thought for maximum efficiency. For the water level, unless previous experience dictates otherwise, a good starting point is even with the mass. From then on, some experimentation is recommended for maximum efficiency: lowering the water level will increase the cutting action of the media and raising the water level will reduce it. The main reason for this appears to be that raising the water level makes the media more buoyant. This is illustrated by the fact that at the seashore it takes less force to raise a stone under water than it does above the surface. In addition to this buoyancy, a water level above the mass will provide an extra cushioning effect to reduce the impinging shocks of parts and chips upon each other. This effect of water level can be used to good advantage when, because of wedging or separating limitations, it is necessary to use a larger or smaller size media than desired. If the action of large media is too harsh, it can be tempered by raising the water level, or if the action of small chips is too slow, it can be increased by lowering the water level. For parts that tangle easily, however, it is better to use small media with the water height even with, or above the mass.

Choosing the Compound

The remaining item to go into the barrel, although not necessarily in this sequence, is the compound. Choice of the compound is very important since, in addition to being a variable that can affect the length of the cycle, it is the material that will safeguard the parts against pitting or corrosion. If the problem is burr removal or radius forming, a detergent type compound to keep the chips free cutting is usually sufficient. If surface refinement or abrasion is desirable, then an abrasive compound is added. The abrasive compounds do not seem to contribute much, if anything, to edge breaking or burr removal unless the media is a non-cutting type.

Choice of compound is very important. If the problem is burr removal or radius forming a detergent type of compound to keep chips free cutting is usually sufficient. If surface refinement or abrasion is desirable then an abrasive compound is added.



The types of compound and their uses was discussed in more detail in part 3, but it should be pointed out that with the large variety of metals and the infinite variety of shapes being processed, there must be many types of compounds. The barrel finishing engineer should be constantly on the alert for new developments in this field which will enable him to do a better or less expensive job on his parts already being processed, or developments which will enable him to barrel finish parts with which he was unsuccessful in the past. Many parts are currently being processed which were abandoned as hopeless as little as a year ago, or results of a year ago have been improved. In most instances this is due to improvement in compounds. Some information can be gained from the trade magazines but more can be gained from the representatives of the barrel finishing suppliers who usually will furnish samples if tests are indicated and who will even help conduct the tests under operating conditions.

Choice of Speed

The speed of the barrel is too important to be neglected since most modern tumbling barrels are equipped with some convenient means of varying the speed of rotation. Once the proper speed is established for a particular job, it is easy to adjust the barrel to the proper speed when that job is repeated. The most common barrel speeds fall into the 10-28 r.p.m. range. The speed of rotation does not contribute as much to the speed of processing as some other factors and the primary concern is not to set the speed so high that the parts are damaged through impinging or bending. Since the barrel running time is comparatively inexpensive, it is better to run the parts a little longer than to take the chance of damaging work.

Soft parts such as zinc, cuprous alloys, extruded aluminum, etc. are usually run from 10-15 r.p.m. and the ferrous parts run at 15-28 r.p.m., depending upon the shape of the parts and the size of the media. Naturally, there are exceptions to these speed ranges which have been developed through experience, but a production job being processed for the first time should be run at a safe speed to make certain of the process. On future runs the speed can be increased to shorten the cycle if desired, but

the parts should be checked periodically to make certain that the speed is not excessive.

Determining Cycle Length

The length of the cycle can be determined only by experimentation or experience on similar parts. More abrading is accomplished in the first hour of rotation than in the second hour, etc. because the solution is cleaner at the beginning of the cycle, and if the problem is deburring or radius forming, the edges of the part are sharp and, therefore, thinner. It takes less stock removal to increase a radius from .000-to .001-in. than it does from .001-to .002-in.

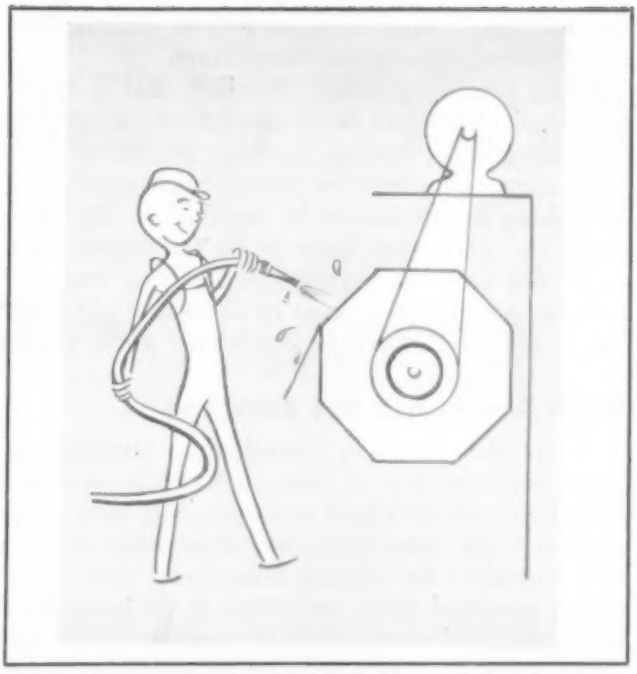
In surface refining, the same principle holds true because the peaks of the surface roughness are sharper and thinner at the start of the cycle than they are at the end of the time and in addition, the abrasive compound is also sharper at the beginning. Therefore, periodic checking on the first run is practically a necessity in setting up the approximate cycle. Future runs will not require this checking. It will be found, however, that the most efficient cycle will not be constant from batch to batch of the same part because burr and surface conditions vary and the media will change in efficiency as it wears.

Rinsing the Barrel

After the cut down cycle, the parts are usually, although not necessarily, burnished. Burnishing is recommended for high color or smoothness or to help prevent residual abrasives from being carried along with the parts into subsequent machining, or plating operations where they will cause trouble. Before burnishing, however, the parts and media should be thoroughly rinsed out to remove all the loose abrasive, cuttings, and abrasive cutting compounds which, if carried off into burnishing, will tend to scratch the work and also upset the balance of the burnishing compound.

Rinsing is best accomplished with the aid of a perforated cover placed on the barrel and usually equipped with a quick change hose connection so that water may be added without removing this rinsing cover. The most thorough rinsing is obtained by filling the barrel with water through this rinse door and then rotating the barrel several times before stopping it, preferably with the flat next to the rinse door in a bottom horizontal position to allow the water to drain. This operation is repeated until the water runs clean.

Sometimes the media used, such as No. 12 aluminum oxide chips, is so small that when the barrel is stopped for draining the media packs against itself and against the perforations in the rinse door so as to prohibit free draining. If this occurs, it is better to rotate the barrel longer without stopping it for draining. It should be remembered that the rinsing operation will remove the pH control of the water induced by the compound, as well as the cushioning effect of the water, so the barrel should not be rotated for too long a time nor allowed to stand with plain water or with no water. Prompt follow up with the next operation is necessary to prevent the rusting or pitting which could occur on ferrous parts.



The most thorough rinsing is obtained by filling the barrel with water through the rinse door and then rotating the barrel several times before stopping it, preferably with the flat next to the rinse door in a bottom horizontal position to allow the water to drain.

Burnishing the Parts

The burnishing cycle using the same media means only a change to a burnishing compound after rinsing. There are many burnishing compounds on the market and different types for different metals. For the best results on a particular part, the supplier should be consulted and tests made with different burnishing compounds. Some variations in results can be made by experimenting with different ratios of compound to water and with water levels themselves. For consistent results, after satisfactory quality has been developed, the amount of compound and water should be controlled closely.

If burnishing in the same chips used in cutting does not yield satisfactory color, it may often be found that a different burnishing compound will give better results—the choice depends upon the particular alloy involved. Or, if the cutting has been abnormally long it may be wise to "bleach" the parts in an acid descaling compound as described in part 3 of this series. This descaling compound can also be used on abrasive impregnated parts which are causing excessive tool wear or other trouble after normal burnishing. In both instances,

the descaling compound is used as an intermediate step between cutting and burnishing.

It has been established definitely that a better burnished surface can be obtained from the smaller chip sizes. If the cutting has been performed in a large chip size (¾-in. or larger) and satisfactory burnishing results cannot be obtained in the same chips, the parts may have to be transferred to a small size chip for burnishing. There is some reluctance to do this because of the extra handling, but in many instances the results are worth while.

Bright Dipping and Ball Burnishing

Where the utmost in burnishing is required, no other medium will produce the results obtained from hardened steel balls or shapes. Soft alloy parts, such as brass, aluminum, etc. often need only be ball burnished for surface refinement, thus eliminating the need for a cut down. If the parts have been run in abrasive chips or compounds for cut down, the best colors can be obtained on the copper alloy metals by bright dipping just before ball burnishing in one of the formulae found in a plating or finishing handbook.

Aluminum parts are usually broken down into two categories, the silicon and non-silicon types. In the past the non-silicon types such as are fabricated from bar stock, extrusions, etc. have been dipped in a hot sodium hydroxide (caustic soda) solution which turns the parts black and then into a nitric acid solution which removes the black color to leave a white satin finish that can then be ball burnished to a beautiful lustre.

Aluminum castings usually contain silicon and in the past have in most cases been dipped in a hydrofluoric acid dip or a hydrofluoric-nitric acid dip before ball burnishing. Since hydrofluoric acid is quite dangerous to work with, attempts are being made to avoid its use in tumbling departments. Recent developments in components have been made which indicate that these dips might be eliminated. A broad statement that these bright dips can be eliminated in all instances may be premature but many aluminum parts formerly being dipped can now be burnished to the desired color and lustre without the use of these chemicals.

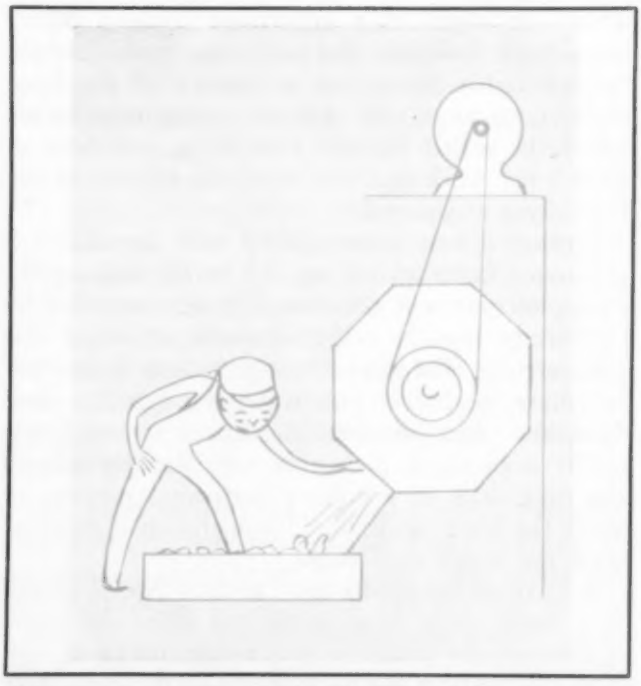
Dumping or Unloading

Most parts can be dumped directly into a hoist pan beneath the barrel. Average parts do not become damaged in this dumping because there are no sharp edges on the parts and because the mass is more or less fluid, which reduces the impact shock. Where extremely critical parts are encountered which cannot be dumped in this manner or when steel balls which bounce out of the hoist pan are being dumped, a canvas chute commonly known as a "boot" can be employed to good advantage. The boot is attached to the opening of the barrel and has a draw string or some similar device at the bottom to control the discharge.

Very heavy parts can be picked out of the mass by hand as it is being dumped. This does not consume as much time as might be thought because if the parts are quite heavy, not too many of them will have been loaded in the barrel. If the parts

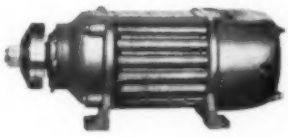
(Continued on page 37)

Aluminum castings usually contain silicon and in the past have in most cases been dipped in a hydrofluoric acid dip or a hydrofluoric-nitric acid dip before ball burnishing. Recent developments in compounds have been made which indicate that these bright dips can be eliminated.

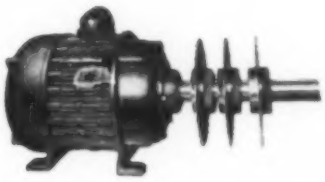


Most parts can be dumped directly into a hoist pan beneath the barrel. Average parts do not become damaged in this dumping because there are no sharp edges on the parts and because the mass is more or less fluid, which reduces impact shock.

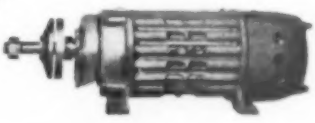
Serving the Industry Since 1852



TYPE L ARBOR 1–30 H.P.
Flatted top or side for maximum cut.



TYPE G ARBOR 1–100 H.P.
Vertical or horizontal application.



TYPE K F ARBOR 1–15 H.P.
Ventilated.

TYPE U ARBOR ½–10 H.P.
For vertical application.

WOODS
PRECISION MOTORS

SHAFTLESS MOTORS.
Furnishing direct drive to high speed spindles at relatively low cost. Available for nearly every class of direct built in application.

TYPE U ½–10 H.P.
With precision base and cutter head mounted.

FULL TAPE INSULATION
gives extra years of service.

Wood's Motors, Motor Arbors and Shaftless Motors enjoy an International reputation for adaptability, flexibility and exceptionally long trouble-free years of service. A Wood's Motor means Positive Power combined with lifetime economy for your industrial requirements.

WRITE TODAY FOR DESCRIPTIVE MATERIALS.

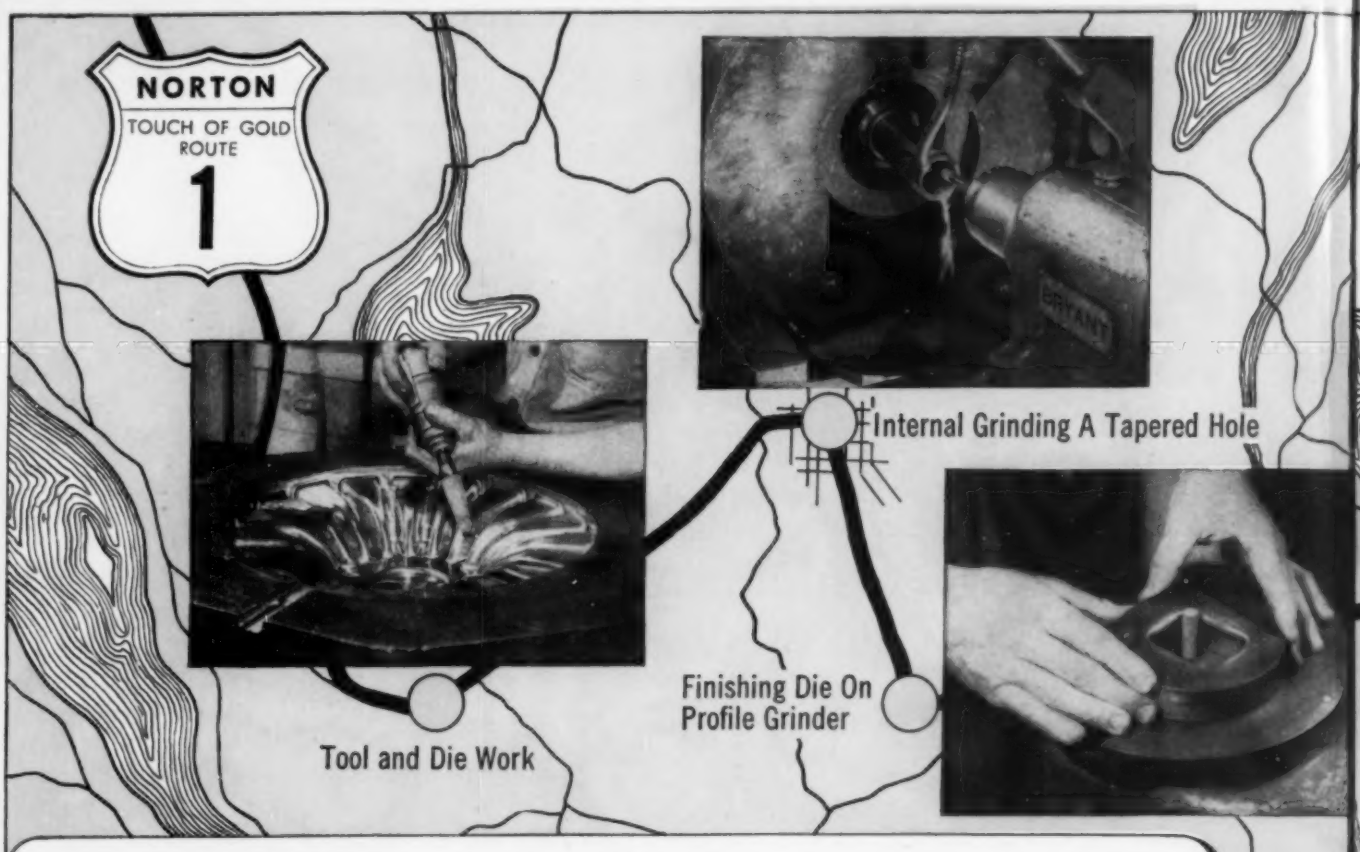
MOTOR DIVISION

S. A. WOODS MACHINE CO.

27 DAMRELL STREET

BOSTON 27, MASS.

Encircle No. 1A on postpaid card



YOUR "TOUCH of GOLD" ROAD MAP TO HARD-TO-REACH GRINDING SPOTS

NORTON MOUNTED WHEELS AND POINTS

bring you big savings on hundreds of small grinding jobs

Norton mounted wheels and points bring the same "Touch of Gold" grinding performance to small or hard-to-get-at areas that the big Norton wheels deliver in the "wide open spaces." Which means that every time you put one to work you get better grinding for less money. Here are some reasons why:

- ***Norton mounted wheels and points stay on their spindles — stay on TIGHT, under severest use. Norton-developed mounting techniques make sure of this.***
- ***They're trued on their own spindles, which assures: (1) perfect concentricity; (2) sharpness and fast-cutting action; (3) accuracy of dimensions and shape. They're ready to go to work immediately.***
- ***They're duplicated identically from lot to lot, thanks to Norton's statistical quality control in processing.***
- ***They're a 100% complete line, for grinding all metals and many other materials . . . made in nearly 200 standard shapes and sizes . . . in the famous ALUNDUM* and CRYSTOLON* abrasives, vitrified or resinoid bonded . . . in diamond abrasives, metal or resinoid bonded . . . and in the laminated, semi-flexible BF construction, resinoid bonded. For ultra-high speed precision grinding, special spindles and cement are available.***

Your Norton Distributor

can help you plan your profit-boosting "Touch of Gold" Route to hard-to-reach grinding spots. See him for the mounted wheels and points you need. Or write to NORTON COMPANY, Worcester 6, Mass. Distributors in all industrial areas, listed under "Grinding Wheels" in your phone directory, yellow pages. *Export:* Norton Behr-Manning Overseas Incorporated, Worcester 6, Massachusetts.

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

W-1648

Snagging A Casting

Touching Up A Die

Finishing Up
A Punch

Lapping
Center Hole

Roughing Out
A Forging Die

to

Chamfering, Polishing, Spot Grinding, Breaking Corners,
Removing Tool Marks, Smoothing Welds, Etc.

N
W NORTON E
S

NORTON

Making better products...
to make your products better

and its BEHR-MANNING division

NORTON COMPANY: Abrasives • Grinding Wheels • Grinding Machines • Refractories
BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure Sensitive Tapes

MICROHONING*

PRECISION

in millionths of an inch

MICROHONING is inherently the most accurate of all production methods used for stock removal. Four major characteristics make Microhoning the controlled abrading process—that produces precision in every part.

Low velocity abrading technique
—low speeds (50-250 SFPM) minimize heat and surface stresses.

Sharp cutting abrasive grits at all times
—the self-dressing action provides clean, constant cutting and uniform surface finish.

Self-alignment of tool with bore
—use of the "float" principle . . . either the tool or workpart has universal action . . . automatically aligns tool and bore to correct bore inaccuracies without changing bore location.

Large area of abrasive in constant contact with work surface
—cutting pressure is evenly distributed over the surface by the thousands of minute abrasive grits collectively removing substantial amounts of stock. There is no localized heat to damage the surface or sub-structure of the metal.

An aircraft hydraulic pump block component, made up of cast iron and hardened steel (58-60 Rockwell "C"); nine ported cylinder bores are Microhoned to obtain surfaces which will maintain a "running" seal and which will not gall or "pick-up." From .006" to .008" stock is removed from each bore while holding these tolerances:

geometry—.000025"
diameter—.000050"

Steel surface finish is held under 8 microinches; cast iron, under 10 microinches. Bores of both sections are Microhoned in line in the same operation.

For a more complete story on this application, write for CROSS-HATCH, Vol. 7 No. 4.

*MICROHONING = Stock Removal + Geometry + Size Control + Surface Finish

MICROMATIC HONE CORPORATION

8100 SCHOOLCRAFT AVENUE • DETROIT 38, MICHIGAN

Encircle No. 3A on postpaid card

(Continued from page 32)

being dumped are to be separated by screening, they usually are dumped directly onto a screening device beneath the barrel opening. If they can be separated magnetically, they are dumped into the hoist pan and transported to the hopper of the separator.

Rust Protection

If the separating cycle on ferrous parts is to be longer than ten minutes, it may be wise to rinse out the barrel and add a protective compound such as soluble oil or some other corrosion inhibiting compound. The barrel is then revolved briefly to coat the parts before dumping. If the parts are to be separated quickly, the barrel finishing compound (not acid) should serve this purpose if not rinsed off.

After separation, the parts can be rinsed and dried in corn cob or dipped in a water displacing oil which will eliminate the drying operation, or they may be given a hot rinse and centrifuged.

Ferrous parts which lend themselves to dipping methods can most economically be dipped in a water displacing oil to remove the rinse water.

Media Storage

After the barrel finishing operation is complete, the media will be used again or stored. Media can be stored most easily in chip bins from which they can be discharged readily into the hoist pan when needed again. Chips present no problem because they can be rinsed before storing with no harmful effect or can be stored with any remaining compound film on them and rinsed before being used again.

Steel media, however, present a more serious problem. It is exceedingly difficult, if not impossible, to obtain a good burnishing job with steel balls which are rusty, dirty or pitted. Steel media can be stored safely in an alkaline solution with a pH of ten or over if covered with the solution. Usually this does not work out in practice because containers often leak or the water evaporates.

An alkaline burnishing soap or a burnishing soap to which some alkali cleaner has been added is probably better because when the water evaporates, the soap will leave a protective film for a longer time than a plain alkali. Oils, of course, are the best protection, but the steel then requires a better cleaning job before re-use since oils and other ingredients mixed with the compounded oils hinder the proper action of many burnishing compounds.

Reconditioning Steel Media

If the steel media are neglected, they can be cleaned and brightened with the proper compounds or they can be run for about eight to ten hours in Vienna lime. If the balls are badly pitted and the above does not produce the desired results, it may be necessary to expose a new surface by grinding in an abrasive compound and then burnishing to a good lustre.

Steel media should be stored as far away as possible from abrasive chips. Contamination of steel media by abrasive chips will cause scratching and marking of the softer metals and it will be found difficult to remove these chips from the steel. Since a load of steel burnishing material can represent an investment of from 25% to 60% of cost of the tumbling barrel itself cannot be overemphasized that extreme care should be taken to maintain the media in prime condition for the best burnishing results and to avoid scrapping it through carelessness.

This chapter has been devoted to basic principles involved in the variables of barrel finishing techniques. Part 5 will include the planning of the tumbling department.

End of part 4. Part 5 will appear in the January issue. • •

SAVE 60%—NEW SURPLUS BENCH GRINDERS

Rugged, precision constructed for continuous heavy duty work. Adjustable babbitt bearings. Includes tool rests. Arbor 21"x1-1/16"x1" at ends. Takes up to 12"x2" wheels. Two flat pulleys furnished. Immediate shipment. Wt. 60 lbs. Satisfaction guaranteed. **Price only $9.95 f.o.b.**, Plymouth, Indiana. V-belt pulley furnished if desired. specify when ordering. Add $2.00 to cost of grinder if requiring V-belt drive. Send check or money order with order or have items shipped open account if well rated company.

CLIZBE BROS. MFG. CO.
DEPT. J, PLYMOUTH, INDIANA

Encircle No. 209 on postpaid card

REPRINTS AVAILABLE

A few reprints of articles which have appeared in previous issues of GRINDING and FINISHING are availble:

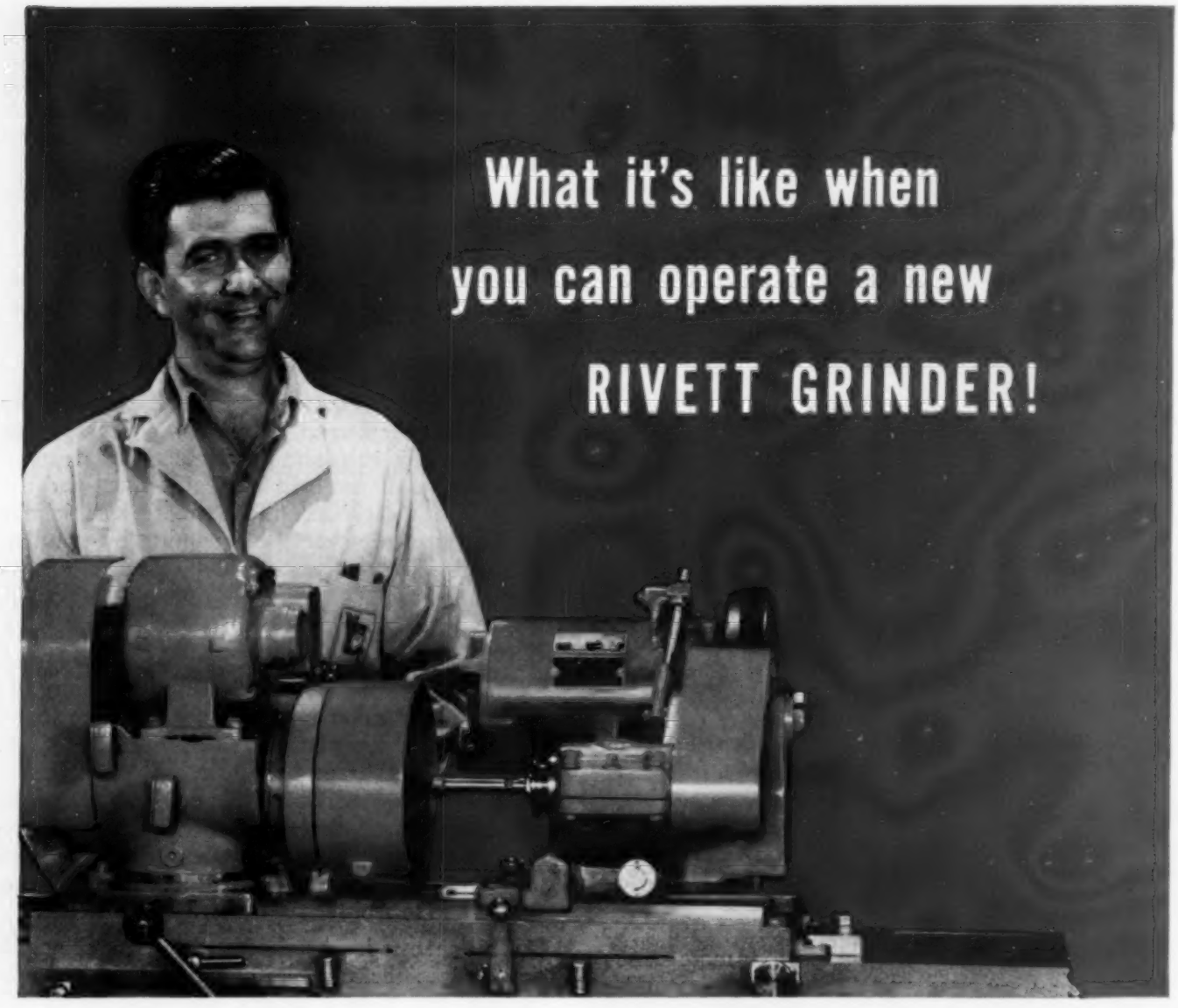
Abrasive Grains, by Joseph J. Forrester.

What Is the Smallest Radius That Can Be Dressed With a Wheel Dresser? By Henry F. Swenson.

Where and How You Can Use Abrasive Rolls, by Robert McAdams and James L. Erickson.

Available at no charge from GRINDING and FINISHING, 222 E. Willow Ave., Wheaton, Ill.

"Wrong button."



a big smile for operators — a big smile for management because both benefit by —

1. Greater output

2. Closer tolerances

3. Reduced set-up time

4. Minimum rejects

Get proof of greater productivity with Rivett Internal Grinders

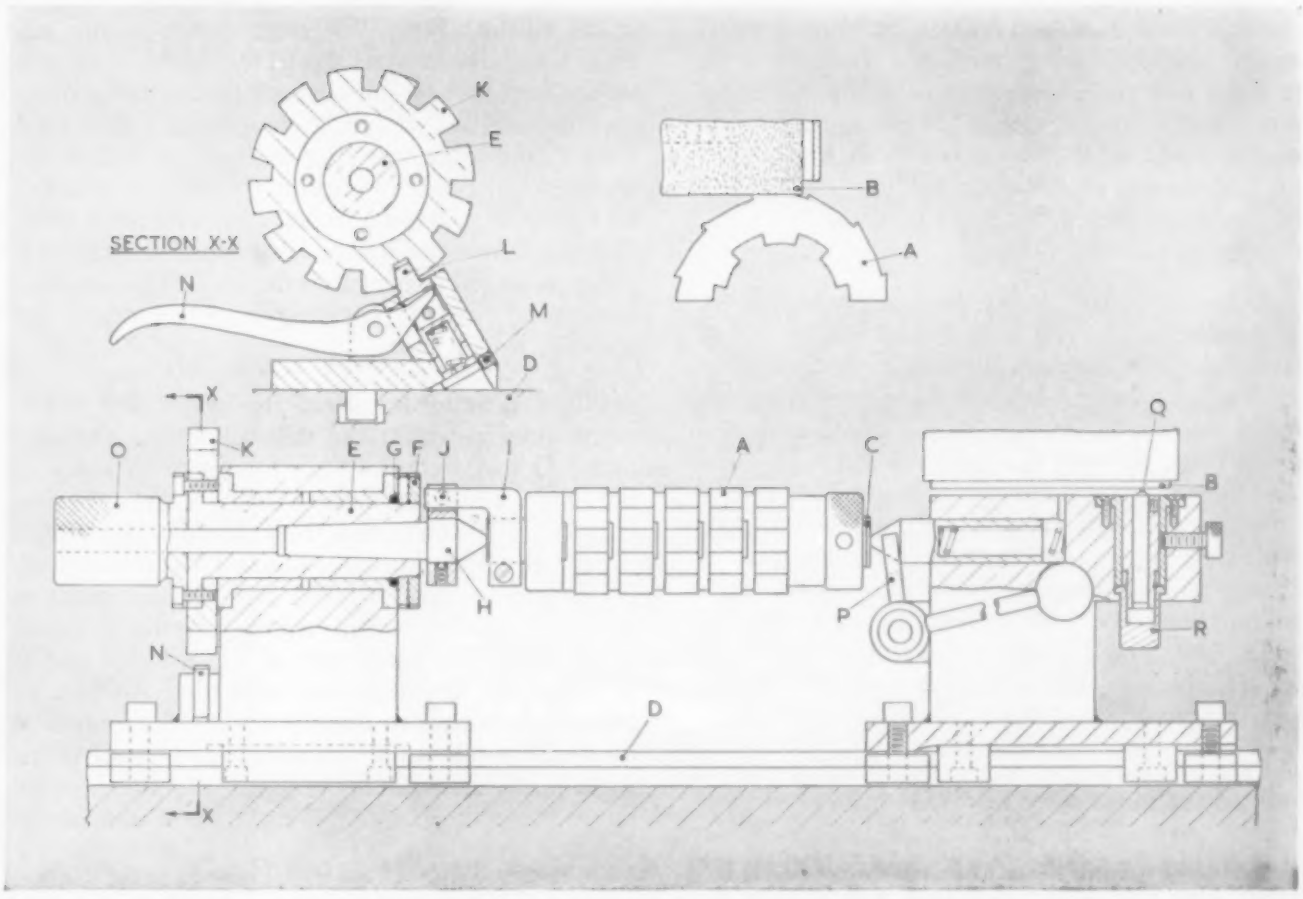
Write for Catalogs and prices today— showing Model 84 with 3" capacity and Model 1024 with 9" capacity

A symbol of accuracy in machine Tools.

RIVETT

LATHE & GRINDER, INC.
Dept. GF12, Brighton 35, Boston, Mass.

Encircle No. 210 on postpaid card



Indexing Fixture for Grinding Ratchets

By **C. T. Bower,** Consulting Tool Engineer
Grinding and Finishing's Correspondent in Great Britain

A COMPONENT produced in large quantities at a regular rate of output is the ratchet wheel which is illustrated in part-section at **A** in the drawing. The part has 12 flats on its periphery which are placed at a radius of approximately 7/8-in. from the axis. Prior to grinding of the flats, the part has been machined completely and heat treated to Rockwell 62 C. The ground finish required on the flat surfaces must have a surface roughness of 12 to 14 micro-inches RMS.

The component forms part of an automatic automobile transmission and acts as a ratchet wheel, co-acting with a series of rollers which engage with the ground flats.

Grinding is by means of a 4 in. diameter cup grinding wheel mounted on the vertical spindle of a surface grinding machine. The wheel is shown partially at **B**, engaging with one of the flats on the component.

For grinding, the components are mounted on a splined mandrel **C** which is centered at each end for placing in the indexing fixture. In actual practice, the mandrel carries six pieces; only five are shown in the drawing for space-saving reasons. The mandrel is hardened and ground on all fitting portions and has a solid flange at one end against which can abut the left hand component. At the right hand end is a nut with a knurled exterior having four holes drilled radially in it for engagement with a bar for final tightening.

The fixture is in two parts comprising a headstock and a tailstock with centers mounted therein for supporting the loaded mandrel. Headstock and tailstock stand directly on top of the grinding machine table **D** and are located thereon by gibs engaging with the central longitudinal T-slot in the table.

Indexing gear for positioning the successive flats on the components in correct relation to the grinding wheel is built into the headstock which is a solid steel block welded to a flat base plate. The headstock

spindle **E** revolves in anti-friction bushings pressed into the headstock block and has a shoulder at its left hand end for engagement with the indexing plate. Longitudinal clearance for the spindle is adjusted by means of the two nuts **F** at the right hand end. The ingress of grinding grit into the spindle bearings is prevented by the felt washer **G** compressed into a recess.

A morse taper center fits into a tapered hole in the spindle and it can be knocked out by a bar inserted through the knock-out hole provided. The projecting portion of the headstock center has a short parallel portion **H** on which is clamped a forked driving plate. Between the forks is inserted the bent tail of the driving dog **I** which is clamped to the end of the mandrel. Once set in place on the mandrel, the driving dog is not removed since alteration of its radial position would also alter the position of the flats on the components in relation to the internal splines. The forked driver has a single screw **J** in one leg which is tightened each time the driving dog tail is mounted in place.

At the left hand end of the headstock spindle is mounted the index plate **K**, a sectional end view of which is shown in Section **X-X**. The 12 radially disposed slots in the periphery of the plate are of wedge section. One side of the slot is on a radial line intersecting the disc axis and the other side of the slot is inclined thereto. This form of slot for indexing plates is backlash free since the spring-loaded indexing pin **L** will fit snugly, even though the slots are not of equal width. When making index plates with wedge shaped slots, it is not necessary to worry about the slot width; the main object is to place the radial side of the slot in the correct position and it is possible to make corrections to incorrectly placed slots when grinding them to final size.

From Section **X-X** it can be seen that the indexing plunger or pin **L** slides longitudinally within a housing welded to the headstock base plate. The pin is of cylindrical section which is easy to grind and lap to a close sliding fit within the bore of the housing.

The plunger is urged into engagement with the indexing plate slots by a compression spring enclosed within it. The lower end of the compression spring bears on a diametrically disposed pin **M** spanning the bore of the plunger housing. Retraction of the indexing plunger is by lifting upward the handle **N** which is pivoted so that the cam-shaped heel portion engages with a cross pin in the plunger. Turning of the headstock spindle and the work between indexing stations is by means of the knurled handle **O** extending from the left hand side.

At the tailstock end, the mandrel is supported on a spring loaded center which slides horizontally in the tailstock body. The center has a parallel exterior which is a close sliding fit within the headstock bore. The means for pulling back the center for mandrel loading is of interest. It comprises a fork-shaped lever **P**, the forks spanning the tapered end of the center point. At its lower end, the fork is mounted on a pivot to which is attached a ball-end hand lever. Pushing downward on the lever causes the tailstock center to be retracted within the body. This is a very economical way of providing retracting means for a spring loaded center.

Wheel dressing is catered for by housing a diamond dresser within the tailstock body. The diamond **Q** and its holder are mounted vertically in the tailstock and are housed within a sleeve having a thread at its lower end. This thread engages with the nut **R** whose exterior is knurled for turning with the finger tips, thus causing the diamond point to be raised or lowered in relation to the grinding wheel face. The plain part of the knurled nut **R** is calibrated in increments indicating 0.001-in. of vertical movement so that the actual distance moved by the diamond can be controlled. The setting of the dresser can be locked by tightening the knurled screw projecting from the right hand end of the tailstock.

The vertical distance between the diamond dresser point and the center axis is the same as the radial distance between the mandrel axis and one face on the component. When the grinding wheel face becomes glazed or loaded, the wheel spindle is fed vertically downward through the amount needed to dress. Dressing can continue until either the wheel is too small or the diamond point has been flattened off so as to be too blunt for useful work. It will be apparent that once the diamond point is set, grinding and dressing can continue through a long period of time. The diamond can be re-set for height several times before it becomes blunted. Size control of the components is automatically achieved.

The grinding cut is allowed to "spark-out" on each step of the component and the output of the fixture is six components, or one mandrel load in 38 minutes. Two mandrels are employed so that one is being loaded while the other is mounted in the fixture. ● ●

Please mention GRINDING and FINISHING when writing advertisers, or use the Handy Reader's Service Card. On the card merely encircle the item in which you're interested. Information will be forwarded promptly.

RADIUS FORMING TOOLS

"TRU-LINE" PROFILE DRESSING TOOLS

IMPREGNATED DRESSING TOOLS

STANDARD DRESSING TOOLS

"TRU-THREAD" THREAD DRESSING TOOLS

DIAMOND GRIT TOOLS FOR THREAD DRESSING

INDUSTRIAL DIAMONDS

1910 *Our 45th Anniversary* **1955**

the 20 horsepower miracle

Pioneering was fashionable in Detroit 45 years ago and we, with our pioneer idea of expertly selected industrial diamonds, had lots of company and customers among the new car and truck builders who were springing up at the average (and incredible) rate of half-a-dozen a month.

And, if we needed inspiration and encouragement in our early business years (and sometimes we did) it was right at hand in the social and industrial miracle of one little car that had been launched with an idea just as pioneering as our own.

Until then, horseless carriages had been for the rich. This car was for the common man. It was light, simple, cheap ($1100 for the Town Car in 1910; $260 for the Roadster in 1924) and—indomitable. With a spunky little four cylinder, 20 horsepower engine, it peformed impossible feats of transportation and endurance.

Orginally, production had been hopefully set at 25,000 cars for the year but in the twenty years of its existence, more than 15,000,000 were built and they changed the pattern of daily life all over the world.

Cars have changed vastly in our time and so have diamond tools, and we have seen our pioneer idea of *expertly selected industrial diamonds* and *Engineered Diamond Tools** become the accepted principle throughout industry simply because they do their job better and at less cost.

**Engineered Diamond Tools* means diamond tools *engineered* to the job and *guaranteed* to do it.

WHEEL TRUEING TOOL COMPANY

77-3200 W. DAVISON AVE., DETROIT 38, MICHIGAN

ESTABLISHED 1910

Southwestern Plant: Dallas, Texas

Distributors in Principal U.S. Cities—Agents Throughout the World

WHEEL TRUEING TOOL COMPANY OF NEW JERSEY
33 West Street, Bloomfield, N. J.

WHEEL TRUEING TOOL COMPANY OF CALIFORNIA
5560 Alhambra Ave., Los Angeles 32, California

WHEEL TRUEING TOOL COMPANY OF CANADA, LTD.
575 Langlois Ave., Windsor, Ont.

Tool and Cutter Grinding Department

Douglas Decentralizes Grinding, M

By **James Joseph**

GRINDING and tooling are companion functions at Douglas Aircraft's sprawling El Segundo (Calif.) plant.

Long before a scheduled machine set-up, Douglas' four decentralized grinding cribs are alerted, via a shop order from the Small Tool Planner.

And when production rolls, machinists find themselves with a ready reserve of carbide tools, sharpened, ground to specs, ready for the job.

Behind it all are two key words: "decentralization" and "tool reserve".

Grinding setup for raking of carbide cutter face.

Grinds upwards of 230 carbide cutting faces with single 5-inch diamond wheel; same type wheel averages 125 carbide peripheries.

Makes Each Sharpening Crib A Specialist

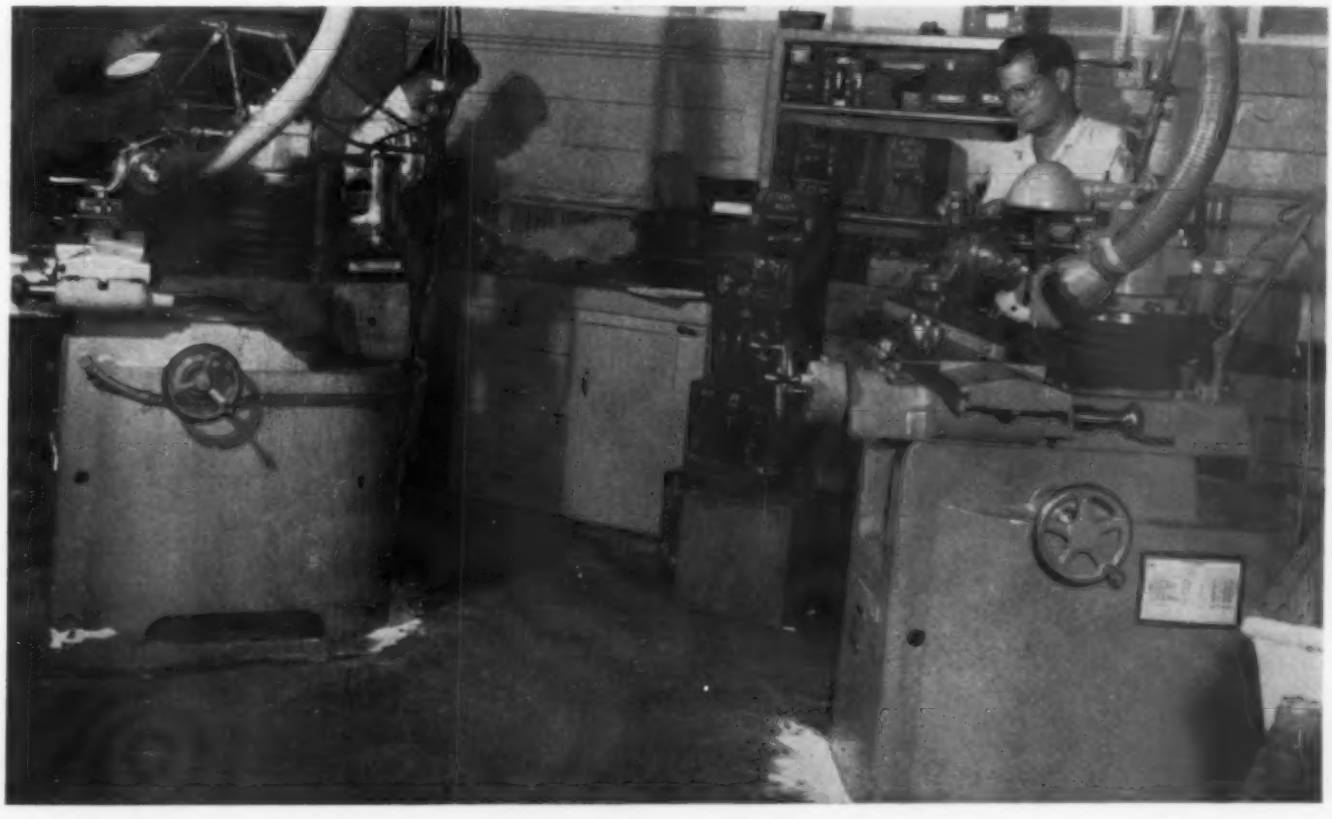
Douglas' four grinding "cribs", really departments with upwards of 25 specialized grinding machines and as many operators, are each specialized as to function. And each is located closely by the production machines it serves.

Example: the "Spar cap" grinding crib, with 20 machines and 18 men, is housed just off the spar-cap machining line. Here work banks of Farnham multi-spindle mills, contouring Duraluminum extrusions from templates. The Spar cap crib fabricates from blanks most Farnham cutters. More important, the crib also sharpens the spar line's cutters, reamers, end mills and boring tools.

Says tool engineer Jack Cowen, "Grinding decentralization is the key. What the Spar cap crib does for the spar line, the form tool crib does for the forming line. Another crib, equally specialized, serves the milling department. And finally, there's a general grinding crib that sharpens everything from mill cutters to carbide single points."

As for "tool reserve"—no machine set-up is begun without at least three (and often more) tools in reserve. That way, one works while a second is being

Typical grinding machines for spar cap mill cutters.



Grinding rake on carbide spar cap mill cutters.

Grinding O.D. or periphery of carbide spar cap mill cutter.

Grinding face or ends on carbide spar cap mill cutter.

resharpened, with a third (at least) in ready reserve.

From such specialization has come a great volume of shop-proven statistics. The Spar cap crib, since it works only tools which fabricate Duraluminum, knows precisely how much grinding it can get from every diamond wheel. And further, since each of the crib's grinding machines is strictly specialized, the data's minutely broken down.

For example, from a 5-in. x 3¾-in. x 1¾-in. x 1¼ diamond wheel shopmen figure to get 230 grindings (when the wheel's specialized to cutter-face sharpening).

Another wheel of similar dimension can be expected to grind 125 carbide peripheries (tho' 205 grindings from a single wheel aren't unusual).

The crib figures a 4-in. dia., ⅛-in. wide diamond wheel for 75-125 grindings when specialized to carbide tool radii.

How many rake angles a diamond wheel can grind varies. All depends whether the wheel's working a straight rake (when 250 operations are expected from a diamond wheel), or a helico-formed cutter (when but 40-60 grindings are "average" before the wheel's discarded or sent to salvage).

At the moment Douglas researchers are studying improved lubricants, seeking ways both on the production line and in the tool crib to: (1) increase time between resharpening; (2) get more grinding from every diamond wheel.

In the Spar cap crib, as typical, a tool in for sharpening is routed machine-to-machine from replacement of carbide tips (if necessary) to final inspection, then returns to tool storage and finally to the production line.

Here's how specialized grinding machines in a specialized department (The Spar cap crib) rework a spar-cutting tool.

The tool, with four carbide tips, arrives at the crib, as do all carbide tools, individually packed in a plywood box. Accompanying the box is a resharpen order from Tooling Control. The box itself is worth noting. It's stenciled with three number-letter codes. One signifies that the particular tool is specialized to a specific production part, let's say an aircraft spar. A second tells what Douglas plane the part fits. The third code describes the tool's basic design and assigns it a place on the "reserve" list. Example: a box coded MC 1 No. 2 means that the tool is a mill cutter, design 1, and further, that it's the second tool on the reserve list. Somtimes as many as 30 identical cutting tools are held in reserve (for very large production orders). In this case, the 30th tool's box would be coded: MC 1 No. 30.

So mill cutter (MC) No. 2 arrives at the Spar cap grinding crib. Let's follow the resharpening, step by step:

(1) **Removal of ungrindable tips or blades. Time: about ten minutes per blade.**

With the tool held in a special fixture, leads from

an induction welder are applied to the carbide cutter. When the tip's red-hot (1200-1400-degrees F), it's removed with tongs.

While still hot, the carbide seat gets a couple of strokes with a wire brush to remove scale.

(2) **Brazing a new tip: Time (for both preparation and brazing): about 23-minutes.**

The tool's allowed to cool, is then sandblasted to remove scale in a 20-in. x 30-in. sandblaster. Takes 2-3 minutes to blast each seat.

After that, a new tip is induction-brazed to the seat using flux and silver solder. Seat and new tip blank are induction heated to a low brazing temperature, 1200-1400-degrees. Secret of good brazing, say Douglas researchers, is plenty of flux and .0035-in. thick silver solder in sheet form.

With the new blank brazed onto the carbide seat, the tool is aircooled, then sandblasted a second time, 5 minutes per cutter.

And finally, brazed area is checked, by using red dye, then white "developer", revealing hidden brazing flaws. Operation takes about 10 minutes.

Incidentally, the Spar cap crib cuts many a special-dimensioned carbide tip. For the operation, crib uses a cutter equipped with a 4-in. dia., 1/32nd width brass wheel, its surface impregnated with diamonds. Feed is variable from 0 to 30-in./min., tho' the usual feed is 5-in./min. Coolant is water soluble. Tips are commonly cut from a 6-inch long carbide blank.

From brazing of new tips (where necessary), the mill cutting tool processes to the next grinding step, raking its cutting faces.

(3) **Raking the faces. Time: about 5 minutes per face.**

Used here, as elsewhere in the Spar cap crib, is a Cincinnati No. 2 universal cutter-grinder. Raking wheel, a 100x100, 5-in. dia. phenolic cup, with ⅛-in. diamond penetration. Grinding gives desired rake to faces. On a 4-cutter tool (as the one under scrutiny), the machine operator first works the top cutter's face, moves to the cutter directly beneath, then works cutters on either side.

(4) **Grinding the periphery. Time: 10 minutes per tip.**

Again, machine is a Cincinnati No. 2 universal, rigged with the same wheel as for rake angle grinding. When grinding periphery on a freshly brazed tip, working time approximates 10-minutes. Only five minutes per tip is needed for resharpening a tip.

(5) **Grinding Carbide Face. Time: about 5-minutes per face.**

Again, it's another No. 2 with the same 5-in. cup-wheel, diamond impregnated. For lubricant, as in the preceding operations, Douglas uses a water soluble fluid, in a mist spray. Mist keeps the operation clean, gets good life from diamond wheel even tho' grinding speed approximates 3400 rpm.

(6) **Grinding the Radius. Time: 15-minutes per tip.**

Tool is set on an arbor, the arbor adjusted for desired radius. Grinding machine: a radius grinder, rigged with a 4-inch, 100 x 100 x ⅛-in. diamond penetration, straight wheel, its width ⅛-inch.

(7) **Balancing the tool. Time: variable—averaging about 30 tools in 5 hours.**

Radius grinding completed (the final resharpening step), the tool's balanced on an electronic industrial balancer outfitted with a special sparcap mill arbor. Balancing speeds vary between 800-900 rpm. If unbalanced, the tool is "drilled out" with a ⅜-inch dia. drill.

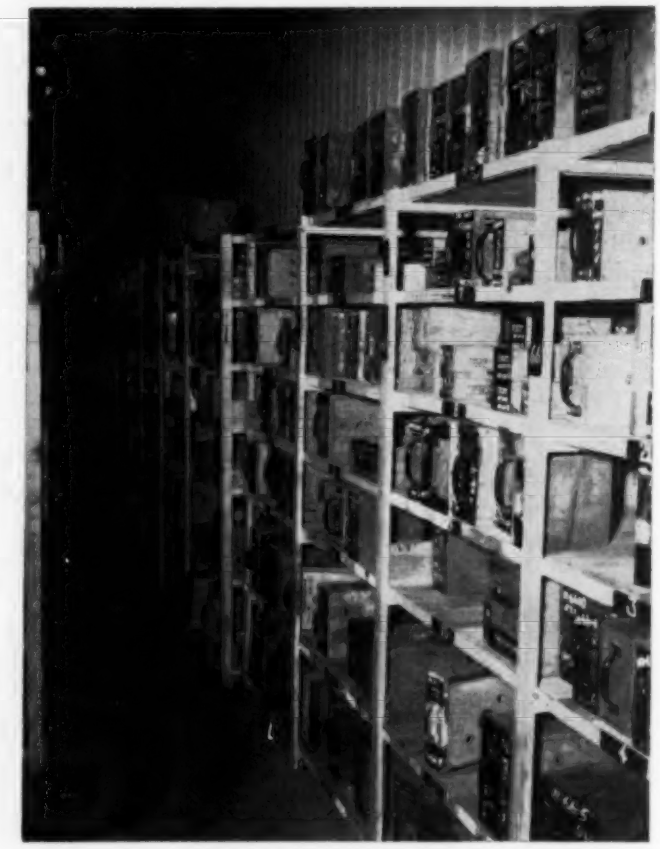
Typical out-of-balance corrections:

(a) if tool is 4 to 6-inch pounds out of balance, the ⅜-inch hole is drilled ⅛ to 3/16-inch deep.

(b) if tool is 2 to 4-inch pounds out of balance, the ⅜-inch hole is drilled ⅛-inch deep.

Checking concentricity on O.D. and end or face runout on carbide spar cap mill cutter.

Grinding radius on carbide spar cap mill cutter.



How Douglas stores its resharpened, reground mill cutters—each in individual, coded wooden box.

(8) Inspection. Time: from 10-20 minutes per tool.

Tool is inserted in a Jones & Lamson optical comparator, the carbide tips projected 10-times actual size on its screen.

Before the inspector are the specs—and they must be strictly adhered to.

Typical "Cutter Data" for the mill cutter:

To cut: Dural

Hand (left or right)—optional

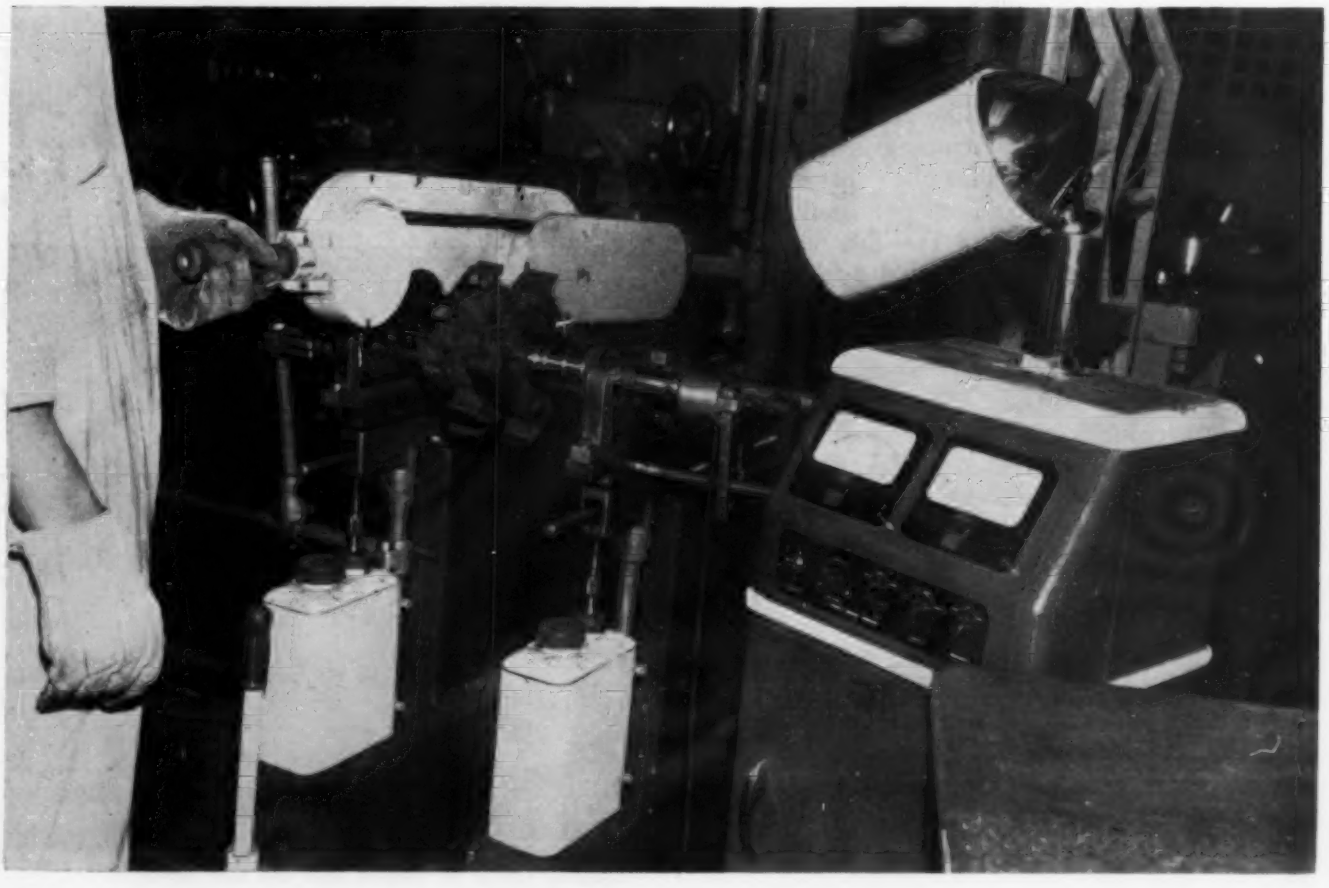
RPM(will run)	3470
Helix angle	10-degrees
Land	1/32
Primary angle	5-degrees
Secondary angle	15-degrees
Tertiary angle	20-degrees
Rake angle	5-degrees
Side clearance	8-degrees
Type	staggered tooth

For such a typical grinding job, tolerances at Douglas are close: the rake angle must be held, for example, to within plus-minus ¼ degree. The periphery must fall within plus-minus .002-in.

If the tool passes inspection, it's reboxed (as it is even when processing grinder to grinder), and is returned to Tool Control. Finally it's reissued to production line machinists.

(Continued on page 49)

Electronic balancing the cutter.



CORTLAND MOUNTED POINTS

For Faster Cutting
Lower Grinding Costs
Longer Life

Faster cutting, lower cost, longer life — these are but a few of many economies effected by Cortland mounted points. Multiply these plus values by the thousands of operations these tools are performing on the production lines and in the tool rooms — operations formerly laboriously accomplished with files, scrapers, chisels.

Cortland supplies a complete line of mounted points in all standard shapes and sizes. Years of abrasive engineering know-how, modern manufacturing facilities and exclusive production features — these are reasons why Cortland is the line you can depend on.

Prime Ingredient:

Integrity

The making of grinding implements in Chester, Massachusetts, has been a family occupation for generations. While the introduction of modern materials and methods have been the means of improving quality and speeding production, the inherent father-to-son pride of craftsmanship continues to be a guiding factor in every phase of Cortland manufacturing.

Because this human quality is not a commodity generally available to a manufacturer, it is one which we prize highly and are proud to be able to incorporate in the products we offer our customers.

Compare these Cortland features

UNIFORM HARDNESS — No soft spots, because Cortland mounted points are formed from solid blanks. This assures that each individual point, regardless of size, is consistent in hardness.

NO BREAK-IN PERIOD is necessary with Cortland mounted points. They are completely shaped on special lathes that produce a smooth-running point that can be used right down to the mandrel.

SECURELY MOUNTED, cannot break loose, because of a special Cortland-developed cement that provides joint strength to meet the most rugged operating conditions.

CORTLAND GRINDING WHEELS CORPORATION

Chester, Massachusetts

CORTLAND

Encircle No. 212 on postpaid card

LE ROY MACHINE CO., LE ROY, NEW YORK

COMPARATIVE FINISHING COSTS FOR JET ROTOR COMPRESSOR DISCS

FINISHING METHOD	FINISH TIME	COST PER DISC	QUALITY	DISCS PER YR.	COST PER YR.	PROD. INCR.	COST SAVINGS
FILE AND WIRE BRUSH	18 HRS.	$124.92	VARIED	231	$28,870	—	—
SUPERSHEEN DBF-200 BARREL	4 HRS.	$ 5.68	UNIFORMLY GOOD	1040	$ 5,907	450%	$124,000

HOW AIRCRAFT PARTS FIRM SAVED $124,000 WITH ONE SUPERSHEEN BARREL

This Almco SUPERSHEEN fixture-type barrel is paying for itself every week.

Compressor rotor discs for jet aircraft must be finished to rigid Air Force specifications at the Le Roy Machine Co., a New York manufacturer of automotive and aircraft parts. Above you see the final inspection of these parts, just barrel finished. Inspected under powerful magnifying glass, critical break-edges of the discs are right down to A. F. specs.

"Supersheen methods were largely responsible for achieving and maintaining the high quality required for aircraft manufacture," reports R. O. Braaten, Le Roy project engineer. Prior to the installation, the rotor discs were deburred by file and wire brush.

Then an Almco finishing engineer recommended that some sample discs be barrel finished . . .

In Almco's Newark laboratory, it was found that deburring these parts required tough, Supersheen bonded abrasive chips, ⅛ in. steel diagonals and abrasive compound to meet strict A. F. requirements and yet get the fastest possible cutting, grinding and polishing action.

That's how the SUPERSHEEN METHOD cut finishing time from 18 to 4 hours per disc, achieving absolutely uniform finish. Too, production was increased 450 percent, saving $124,000. annually on deburring costs.

Remember, the SUPERSHEEN METHOD is a complete barrel finishing service that begins with an Almco finishing engineer analyzing your specific problem. Then free tests are conducted on your sample parts at the Almco laboratory nearest your plant. The correct media, compounds, barrel rpm, water level and time cycle are determined in order to precision finish those parts; often a complete test can be run in a matter of hours.

Helping you select the correct size barrel or barrels for your operation is the next step. And whenever you need expert help in finishing problems, ALMCO is at your service. For further information and literature, write, Almco, 1312 Marshall St., Albert Lea, Minn.

ALMCO

Division of Queen Stove Works, Inc.,

ALBERT LEA, MINN.

SUPERSHEEN METHOD
FOR
SPEED FINISHING

ALBERT LEA • NEWARK • DETROIT
PHILADELPHIA • NEW HAVEN
LOS ANGELES

Encircle No. 213 on postpaid card

(Continued from page 46)

Spar cap crib leadman Dick Jarrett keeps a performance record, an individual file card, for every grinding wheel. Thus, he knows that radius wheel No. 6 (a 4-inch diameter, ⅛-inch wide straight wheel) was discarded after working 71 cutters. Another, working the same job, ground 88 cutters. Another—91. The average: between 75-125, with most wheels managing to grind about 80 cutters.

To maximize tool life and keep track of tools Douglas issues but one mill fixture to a machinist, holds the others in a padlocked "reserve crib". And a tool must be turned into Tool Control for resharpening before a reserve is issued. ● ●

Please mention GRINDING and FINISHING when writing advertisers, or use the HandyReader's Service Card. On the card merely encircle the number of the item in which you're interested. Additional information will be promptly supplied.

"Where's that grinding wheel you asked me to dress?"

NEW 1955 MODEL "SS"

SOMERSET RADIUS DRESSER
outperforms them all

Cut production time without sacrificing accuracy! Easy to set, easy to see, eliminates necessity of guard removal. Somerset Radius Dresser turns "tricky" jobs into routine operations. Write for free folder and price list.

At new low price with diamond
$124.50

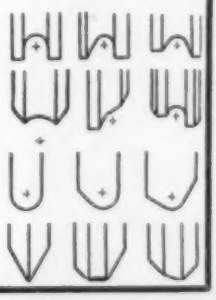
SOMERSET TOOL CO.
2290 Virginia Ave. Hillside, N. J.

Encircle No. 214 on postpaid card

WHY WASTE TIME?

Dress Profiles like these in a few minutes without Templates or Crusher Rolls with the Jeon Automatic Angle Tangent to Radius Dresser. It's fully universal.

Patented



Write for Price and Folder. Representatives Wanted.

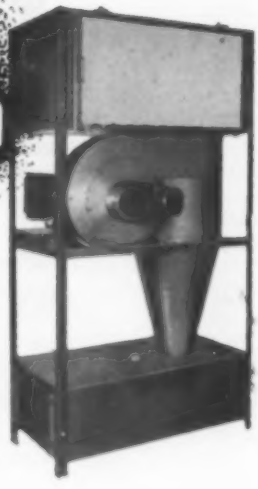
CONCAVE DRESSING TOOL

JEON MANUFACTURING CO.
P. O. BOX 6750 WASHINGTON 20, D. C.

Encircle No. 215 on postpaid card

EFFICIENT—LOW COST

Dust Collection



Easy installation . . . efficient low-cost operation . . . simplified maintenance, make Dustkop *FIRST* among equipment to collect most all industrial dusts. There are Dustkop models to eliminate your dust problems . . . that are space saving, self-contained units; or exhaust type for rafter, ceiling or outside location. Write for descriptive literature.

37 STANDARD MODELS TO CHOOSE FROM
• READY TO USE

Also a Complete Line of Mist Collectors

AGET MANUFACTURING COMPANY
1380 E. CHURCH ST. • ADRIAN, MICHIGAN

Encircle No. 216 on postpaid card

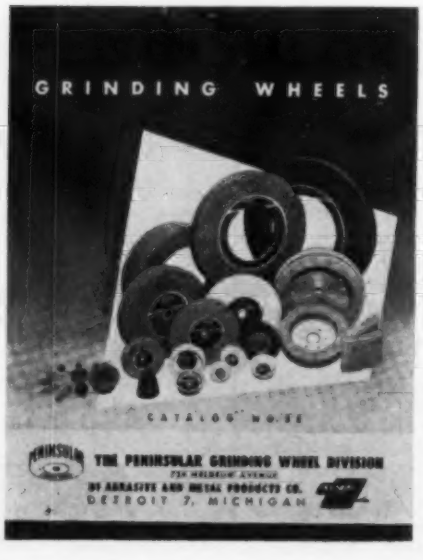
Available Literature

Catalogs and Bulletins Available from Manufacturers

For copies of the literature in which you have an interest use the postage-paid postcard. Merely circle the identifying number and mail the postcard.

1. Grinding Wheels. Catalog No. 5E, issued by the Peninsular Grinding Wheel Div., Abrasive and Metal Products Co., Dept. GF, 729 Meldrum Ave., Detroit 7, Mich., describes and illustrates their stock abrasive items. Included is general information, sizes and specifications, list and unit net prices, a standard wheel marking chart, bonds and abrasives listing, and standard types of grinding wheel shapes.

(See Number 1.)



2. High Frequency Wheelheads. A new 8-page folder published by Bryant Chucking Grinder Co., Dept. F, Springfield, Vt., describes and illustrates the new series 800 high frequency wheelheads. Complete technical data is given, plus information on alternators and hi-frequency motors. These wheelheads are said to give speeds from 10,000 to 100,000 rpm, finishes as fine as ¼ of a micro-inch, and low cost maintenance.

(See Number 2.)

3. Grinding and Lapping. Norton Co., Dept. FG, Worcester 6, Mass., has just published a new 32-page general catalog of its precision grinding and lapping machines. Catalog No. 1843 contains photographs and specifications of the Norton line of machines which include cylindrical grinders, cam shape and crankpin grinders, tool and cutter grinders, universal grinders, surface grinders, lapping machines and special purpose grinders.

4. Surface Roughness. A new folder from Micrometrical Mfg. Co., Dept. G, Ann Arbor, Mich., tells how to specify surface roughness and why. Included in the folder are sections covering the practical advantages of surface roughness specification; how to establish roughness specifications; how to specify surface roughness on working drawings and shop prints; and measuring surface roughness in the shop.

5. Thread Grinders. A new bulletin that reveals advances made in their styles 33 and 33-L precision thread grinders, has been announced by Ex-Cell-O Corp., Dept. GG, 1200 Oakman Blvd., Detroit 32, Mich. These grinders are high production, automatic machines for grinding extremely accurate external threads. Both machines will handle work up to six inches in diameter. A variety of aircraft engine parts, taps, thread chasers, lead and adjusting screws, worms and other workpieces produced by the two machines are pictured in the new bulletin.

6. Pneumatic Gaging. The pneumatic gaging method is a means of gaging which measures the back pressure created when the part being tested partially limits the flow of air through one or more nozzles of constant size. The line of Air-O-Limit Comparators is described and illustrated in a new catalog published by the Pratt & Whitney Div., Niles-Bement-Pond Co., Dept. F, West Hartford 1, Conn. These comparators are said to be fast, accurate, dependable, non-contacting, self-cleaning, mechanically simple, and extremely versatile.

7. Gear Grinders. Catalog No. GG-52 published by The Sheffield Corp., Dept. FG, Dayton 1, O., describes and illustrates their model 140 for the production of precision ground helical and spur gears. The multiple ribbed wheel principle of the model 140 is said to offer many advantages that were previously not available. Specifications are included along with a list of standard equipment and extra equipment available.

8. Vertical Grinders. A new literature series covering its vertical universal grinders has been published by The Springfield Machine Tool Co., Dept. FF, Springfield, Ohio. The series includes bulletin 197, a general brochure, and bulletins 198, and 200, data sheets on individual models. The bulletins explain the principles of vertical grinding, show application photographs, and provide technical details of performance and construction.

9. Mandrels. Erickson Tool Co., Dept. RG, E. 23rd & Hamilton Ave., Cleveland 14, O., has announced a new 4-page bulletin covering their newly acquired line of Westberg Colletmandrels. This one-piece mandrel, actuated in the same manner as collets, has been introduced to meet the need for an inexpensive, accurate, expanding mandrel. Westberg Colletmandrels are designed so that they can be machined in place on the machine.

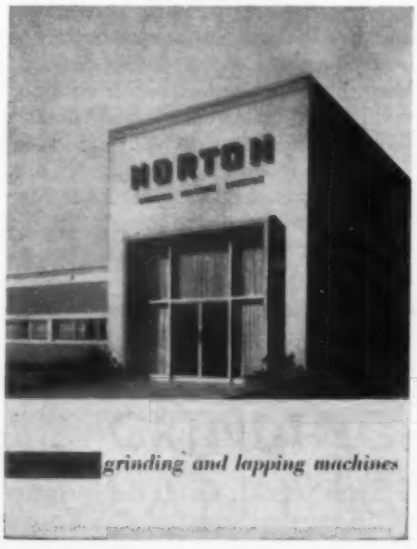
10. Holding Tools. A new catalog, No. 9155, containing descriptions of the entire line of work-holding tools built by Universal Vise and Tool Co., Dept. F, Parma, Mich., is now available. It includes information on vises for angle machining, adjustable lathe fixtures for increasing the usefulness of lathes and turret lathes, safety work-holders for drill presses, and many other special and standard work-holding devices.

(See Number 11.)

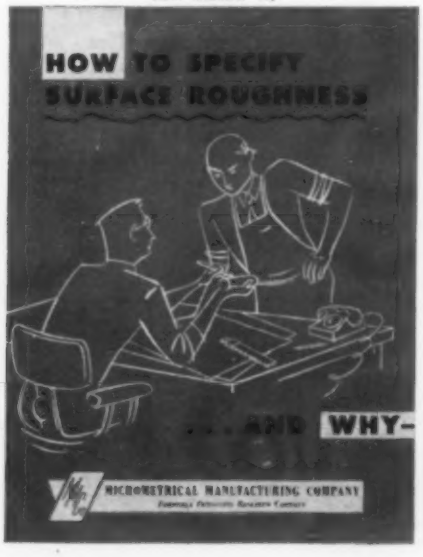
11. Magnetic Chucks. Taft-Peirce makes two types of magnetic chuck, electromagnetic and permanent magnet. Electromagnetic chucks derive their power from direct current, whereas permanent magnets supply the holding power for permanent magnet chucks. Catalog No. 412, available from Taft-Peirce Mfg. Co., Dept. G, Woonsocket, R.I., also contains descriptions and illustrations on magnetic chuck accessories and magnetic work drivers.

12. Diamond Tools. A new industrial diamond tool catalog is available from Diamond Products, Inc., 321 Prospect Ave., Elyria, O. It contains illustrations and tool specifications covering diamond tool dressers, thread grinding dressers and center cones. Tools listed range from various single and multiple point tools to diamond impregnated types. Also included are the new Vinoy

(See Number 3.)



(See Number 4.)



(See Number 12.)

diamond impregnated wheel dressers and expanding type reamers.

13. The Productive Time and Energy Analyzer integrates the two elements, productive time and productive energy, necessary to determine: machine utilization; best cutting tool, cutting oil, coolant; cutting tool life standards; machinability index; horsepower at the tool necessary to remove 1 cu. in. of metal per minute; tangential cutting force in pounds, etc. This colorful catalog is available from Stewart Instrument Co., Dept. RG, 6507 Grand River Ave., Detroit 8, Mich.

14. Discs & Wheels. A new 20-page catalog, No. AC-55, illustrating and describing its complete line of abrasive discs and cylinder wheels has been published by Gardner Machine Co., Dept. GR, Beloit, Wis. In addition to a chart showing the variable factors influencing the selection of abrasive discs and cylinder wheels, the catalog describes the types and sizes of abrasives manufactured to meet the various flat surface grinding requirements.

15. Diamond Compound. A new specification chart and price list of Precision virgin block diamond compound is available from Precision Supply & Machine Co., Dept. FG, 292 Belmont Ave., Paterson 2, N. J. Compound is guaranteed and is laboratory controlled for crushing and grading to exacting specifications of government standards, making possible uniformity of the highest order.

16. Barrel Finishing Compounds. Four classes of precision barrel finishing compounds are described in a new set of four-page illustrated brochures prepared by Newton Industries Inc., Dept. GG, 100 Saw Mill Rd., West Haven, Conn. The compounds described are for a wide range of barrel finishing operations, from heavy deburring and cutting, to regular deburring, burnishing and cleaning. Rinsing and neutralizing compounds for between-stages operations are also described.

17. Portable Air Tools. Bulletins No. 1020A and 1040A published by Master Pneumatic Tool Co., Inc., Dept. F, Bedford, Ohio, describe and illustrate their line of drills, nut setters, screw drivers, and impact wrenches. Master Power Drills are available in many speeds with capacities from 1/16″ to ⅜″ holes. Impact wrenches are available in the model M-920 with ¼″ capacity; model M-950 ⅜″ capacity; and J-970 with a ¾″ capacity.

18. Microhoning. A 32-page catalog that was designed to show the advantages of the Microhoning process, the salient features of Microhoning equipment, and the scope of Micromatic services and aids is available from Micromatic Hone Corp., Dept. RG, 8100 Schoolcraft Ave., Detroit 38, Mich. This catalog reflects Micromatic's policy of offering complete honing service and guaranteed results through use of the latest engineered equipment.

19. Grinding Wheels. Suggestions and recommendations for tool room and surface grinding jobs are included in this new illustrated catalog available from Macklin Co., Dept. GF, Jackson, Mich. Illustrations show the grinding of milling cutters, reamers, hobs, broaches, thread chasers, taps, twist drills, gages, lathe and planer tools, dies, stellite tools and many other operations. Also included are segmental wheels, cut-off wheels, and mounted points.

20. Magnetic Separators. How Leland Electric Co., of Dayton, O., saved $2300 in one year after installing Houdaille Magnetic Separators is described and illustrated in a new case history bulletin from Houdaille-Hershey of Indiana, Inc., 977 Sixth St., Lebanon, Ind. The bulletin No. 601, details the operation of the magnetic separator with illustra-

Yes! Here's an effective method for handling polishing paper that has a definite place in many inspection departments and mechanical laboratories. The JOHN CRANE Portable Polishing Stand provides in a matter of seconds a wrinkle free 12″ x 12″ section of paper held absolutely taut over a metal stage that has been lapped to provide a perfect polishing surface. It also permits the instant replacement of this section of paper once it becomes worn.

For further details and other facts on this very practical tool, write for Bulletin L-410.

Lapmaster DIVISION

Crane Packing Company
6417 Oakton St., Morton Grove, Ill.
(Chicago Suburb)
In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

38 YEARS INDUSTRIAL PROGRESS

CRANE PACKING COMPANY

Encircle No. 217 on postpaid card

tions, diagrams and text. The separator employs a powerful magnetic drum to remove contamination from all water-based or mineral oil coolants.

21. Polishing Head. Bulletin No. 102, published by Grinding and Polishing Machinery Corp., Dept. RG, 2530 Winthrop Ave., Indianapolis 5, Ind., describes and illustrates the Vonnegut brush-backed polishing head. These polishing heads are said to be ideal for sanding, polishing, deburring and other finishing operations—for flat, formed, curved and irregularly shaped surfaces—for machined, pressed, stamped, fabricated and moulded parts —for wood, metals and many other materials.

22. Coolant. A new brochure published by Cincinnati Milling Products Div., The Cincinnati Milling Machine Co., describes and illustrates Cimplus coolant for grinding cast iron and steel. Cimplus is a concentrated chemical solution with exceptional rust control. When diluted with water it forms a colorless, odorless fluid which has a variety of uses as a coolant. Principal features, dilutions, and packaging are also given.

23. Coolant. A bulletin describing two products of the Cutting Tool Mfg. Div. of the Motch & Merryweather Machinery Co., Dept. F, 1250 E. 222nd St., Cleveland 17, Ohio, is available. Triple C grinding coolant, is now available in a new form, namely liquid, having initially been introduced in crystalline form only. Triple C Machine Cleaner, a new product, has been developed for the express purpose of dissolving accumulations of insoluble soaps and similar deposits in the coolant systems of machine tools.

24. Automatic Grinder. The No. 18C Blanchard grinder, introduced at the Machine Tool Show, has been developed over a period of seven years. It is said to accomplish by means of automatic cycle control, most of the operations ordinarily performed by the operator when running a standard No. 18 grinder, including the most important item of size control. On suitable work, it is said a tolerance of $\pm .0005''$ can be held in regular production. The Blanchard Machine Co., Dept. FG, 64 State St., Cambridge, Mass.

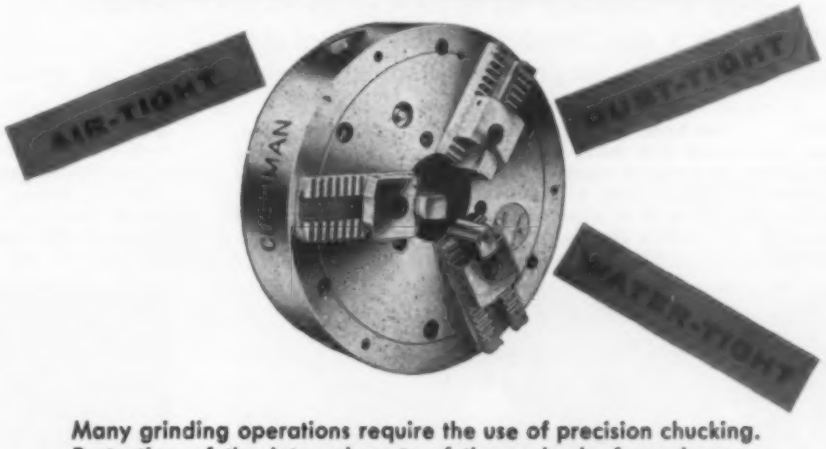
25. Abrasive Belt Grinding. "How Abrasive-Belt Grinding Increases Production," a new 31-page booklet consisting of 46 illustrated case histories, has been announced by the Engelberg Huller Co., Inc., Dept. RG, 831 W. Fayette St., Syracuse 4, N.Y. Application studies are grouped according to each of five types of abrasive belt machining; platen, contact wheel, formed wheel, centerless, flexible belt, and cover a wide range of materials; ferrous and non-ferrous metals, glass, wood and plastics.

26. Cleaning Equipment. The application of specially designed airless blast equipment to 56 production cleaning problems, such as those encountered with cast, welded, forged, heat treated, and machined components used in automotive, railroad, ordnance, farm, and all sorts of other equipment and machinery is fully described in a new 34-page brochure published by Wheelabrator Corp., 1169 S. Byrkit St., Mishawaka, Ind. This catalog, No. 724, has accompanying drawings and photographs along with performance figures given for specific cases.

27. Colloidal Dispersions. A newly revised 4-page booklet, listing 42 colloidal and semi-colloidal dispersions for the metalworking, foundry, and related industries, has just been issued by Acheson Colloids Co., Div. of Acheson Industries, Inc., Dept. FF, Port Huron, Mich. These products include dispersions of graphite, molybdenum disulfide, mica, vermiculite, zinc oxide, and acetylene black. Carriers and diluents are given for each product along with typical applications and important physical data.

CUSHMAN *Air-tight* CHUCKS

FOR WET OR DRY GRINDING OPERATIONS



Many grinding operations require the use of precision chucking. Protection of the internal parts of these chucks from damage due to excessive dust or abrasive particles has always been a problem. Cushman "Air-Tight" Chucks are completely enclosed and sealed against entry of air, water and dust.

Cushman "Air-Tight" Chucks require adapter plates for mounting and are available in 7½", 10", 12" and 14" sizes (other sizes on application). Special master jaws are of heat treated alloy steel, and top jaws are designed to permit a wide range of holding capacity.

Specify Cushman "Air-Tight" Chucks for your wet or dry grinding operations.

CUSHMAN CHUCKS . . . *A Product of American Quality, Labor and Materials.*

CUSHMAN CHUCKMAN CHUCKS

THE CUSHMAN CHUCK COMPANY
Hartford 2, Connecticut
a world standard for precision

8CS55R

manufacturers of
Air Operated Chucks, Cylinders, and Accessory Equipment . . . The Cushman Power Wrench . . . Cushman Manually Operated Chucks and Face Plate Jaws.

Encircle No. 218 on postpaid card

By **Edmund Mottershead,** President
Mottershead Associates
Chicago, Ill.

GRINDING safely

When Dressing A Wheel

LIKE any cutting tool, a grinding wheel needs a certain amount of care to perform properly. The purpose of truing a wheel is to shape its cutting face to a "true" surface. The purpose of dressing is to improve or alter the cutting action of the wheel. In this sense, dressing is a "sharpening" operation.

Dressing a wheel face does not necessarily true it. A wheel face may be sharpened by dressing it to a coarse, fast-cutting surface for rough grinding, and still be out of round or out of parallel.

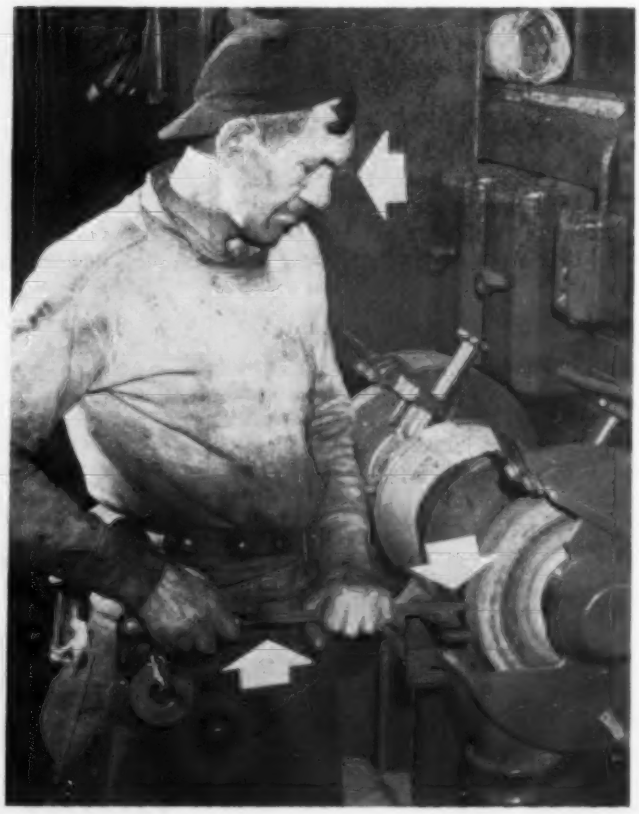
With ordinary stand grinders such as are found in most tool rooms and shops, the dressing tool provided by the manufacturer for a specified type of wheel should be used. If the wheel face is wider than the width of the dressing tool, the tool can be traversed by hand with a slow, steady motion, provided that the tool work rest on the grinder is adjusted properly and that the operator has a firm grip on the tool.

Just as in grinding a piece, you apply pressure gradually so that the wheel has a chance to heat up gradually and evenly, so in dressing you should apply pressure lightly at first and more heavily as the dresser takes hold. Crowding the wheel in dressing may not only cause gouges or pits in the wheel, but may also cause the rim to heat up too fast and create conditions where wheel breakage and an accident may occur.

Wheels should be dressed under the same conditions as operating—dry grinding wheel should be dressed dry etc. Wheels should be dressed at operating speeds or slower, never at higher than operating speeds. When using mechanical dressers, abrasive wheels, or diamond tools, keep predetermined rates of traverse and depth of cut consistent throughout the operation. ● ●

RIGHT . . . Our hero, who is really an old hand at the game, wears face shield and takes a firm grip on a proper dressing tool holding it properly against the wheel face. Work rest is moved in to within 1/8-in. of the wheel, where it should be for most grinding as well as wheel dressing. Note that face shield fits easily over safety glasses, which he wears all the time in the shop anyway. The right way is the safe way.

WRONG . . . An experienced machinist, here posing as "Joe Jerk", demonstrates several of the wrong ways to dress a wheel. No goggles or face mask, he exposes himself to possible eye injury, and increases the risk by failing to use a proper dressing tool. An old file, or other piece of junk is absolutely the wrong thing to use. In addition, he has the work rest out too far from the wheel, creating another hazard.



Proficorder for Recording Magnified Surface Profiles

Micrometrical Development Corp., 2821 S. State St., Ann Arbor, Mich., has announced the new Proficorder—a mechanical-electronic instrument that provides a magnified chart record of the profile of internal and external machined and finished surfaces.

This instrument records (1) waviness, bows, steps and other widely-spaced irregularities, with surface roughness omitted, (2) roughness irregularities alone, with waviness omitted, or (3) the combined roughness and waviness profile. Selection is made by push buttons on the control panel. The charts show the true height and spacing of the surface irregularities, and open up new possibilities in pro-

Figure 1.

SIMONDS
ABRASIVE CO.

"Yes Sir . . . we've got 50 Simonds Abrasive Grinding Wheels of that specification in stock!"

A126 S7 B1

Your Industrial Supply Distributor

HAS THE ANSWER FOR THE SERVICE YOU WANT . . . WITH THE SAVINGS YOU NEED

He does more than supply Simonds grinding wheels. He knows where and how they are used . . . and which specifications to recommend for your jobs. He's your friendly, dependable source for:

THESE PRODUCTS
Grinding wheels . . . abrasive segments . . . cut-off wheels . . . mounted wheels . . . polishing grain . . . tumbling abrasive . . . bricks, sticks, and stones.

THIS SERVICE
Instant quotation of consumer net prices. Quick delivery for your day-to-day needs. Factory engineers for your tough grinding jobs.

THESE SAVINGS
Your distributor's stockroom is your storeroom . . . saving you outlay for large wheel stocks. Less clerical, warehousing and handling expense.

For dependable bonded abrasive products and abrasive grain . . . for prompt, cost saving service CALL YOUR Simonds Abrasive Co. distributor

SIMONDS
ABRASIVE CO.
PHILADELPHIA 37, PA.

EXTRA SAVINGS FROM YOUR SIMONDS DISTRIBUTOR
STOCK · SERVICE · KNOW-HOW

Branch Warehouses: Boston, Detroit, Chicago, Portland, San Francisco • Distributors in Principal Cities
Division of Simonds Saw and Steel Co., Fitchburg, Mass. • Other Simonds Companies: Simonds Steel Mills, Lockport, N.Y., Heller Tool Company, Newcomerstown, Ohio, Simonds Canada Saw Co., Ltd., Montreal, Quebec, Lion Grinding Wheels Div., Brockville, Ont. and Simonds Canada Abrasive Co., Ltd., Arvida, Quebec

Figure 2.

duction setup and inspection, quality control, and research and development work. In addition, a meter on the control panel shows the average height of the roughness profile being recorded.

This Proficorder includes a tracer, a pilotor, and an amplicorder. All working parts are mounted on or in a desk-type console, as illustrated. The piece being profiled is placed on the Pilotor base plate (see Fig. 1); and the piloting mechanism moves the tracer in a plane parallel to the work surface at .005" per second, over any desired length of trace from 1/16" to 1½".

The tracer is a differential-transformer-type transducer. It has a stylus with a diamond tip of .0005" or .0001" radius which moves along the surface; and the output voltage of the tracer is modulated in accordance with the vertical position of the stylus. This voltage goes to the amplicorder amplifier in the back of the console; and the amplified voltage operates the pen meter of a recorder in the lower drawer of the console (Fig. 2), so that the amount of pen movement is proportional to the vertical displacement of the tracer tip. Six vertical magnifications are provided from .000025" to .0005" per chart paper division (approximately 10,000x to 500x), and are selected by push buttons on the control panel.

A gear shift lever on the recorder chart drive (Fig. 2) provides 7 horizontal magnifications, from .001" to .100" per chart paper division, approximately 500x to 5x.

The pilotor illustrated has a vertical adjustment of 7½" and a tilt adjustment of 5° each side of horizontal. The tracer enters a ⅛"-diameter hole to ¼" depth and a 3/16" hole to 1-5/16" depth, and can be used on

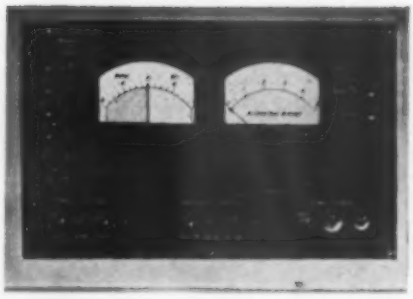


Figure 3.

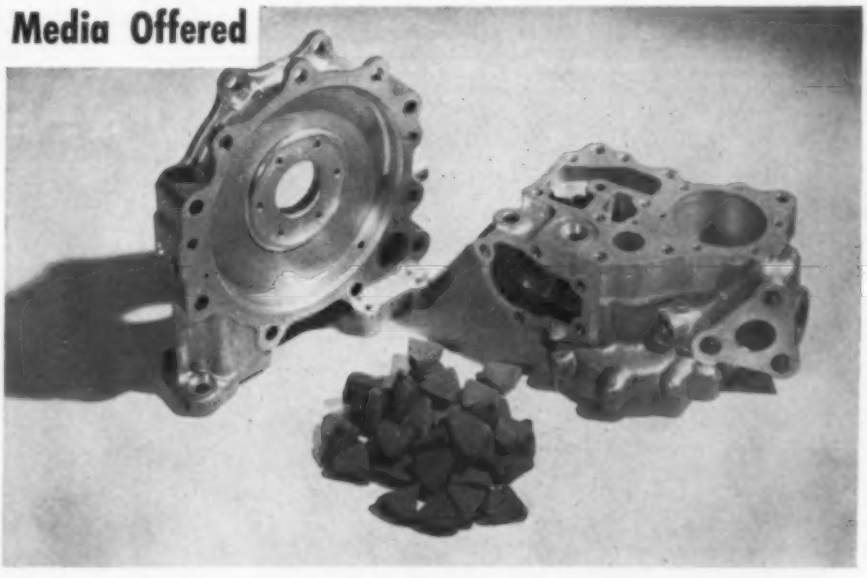
all external surfaces that can be positioned beneath it on the pilotor base plate. Long-shank diamond holders can be furnished for measuring over shoulders.

For simplicity of operation, the controls consist entirely of push buttons, and all are located on one convenient control panel (Fig. 3). The control panel also has a set-up meter that facilitates aligning the path of tracer movement parallel to the surface to be profiled.

Detailed specifications are given in Bulletin LT16, available on request. •

Use HANDY Postpaid Card. Encircle No. 101

Two New Barrel Finishing Media Offered



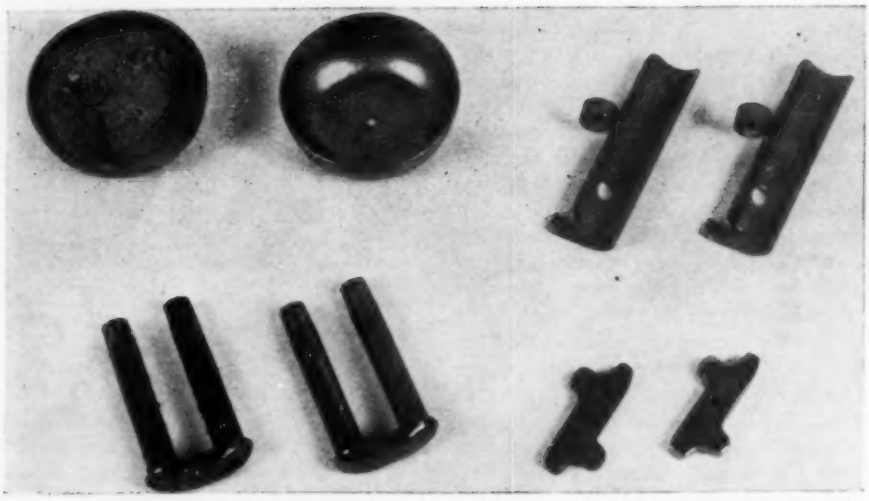
Two new barrel finishing media have recently been placed on the market by Norton Co., Worcester 6, Mass. The first, known as Tumblex T consists of Alundum vitrified bonded triangular shaped abrasive. This was developed to overcome the problem of the wedging of abrasive in parts being tumbled. The second new media, Tumblex N is a natural material. This is being used with good results in finishing, and especially die castings where conventional abrasives frequently cut through the outside protective layer of the casting exposing the porous structure beneath.

After considerable experimentation with a variety of different shapes, Norton determined that the triangular shape showed the least tendency to wedge. For finishing parts with holes, slots and recesses, many manufacturers have had to resort to hand finishing in the past because picking wedged abrasive from these openings took longer than hand finishing in the first place. The introduction of these new triangular molded shapes of abrasive means that many intricate parts can now be barrel finished with all the benefits of economy and better finish than this method makes possible.

These are the specific advantages of the new Tumblex T molded shapes:

1. Uniform size and shape to prevent wedging.
2. Faster cut with no cutting compound required. This reduces cutting time and cost per piece.
3. Maximum surface contact between abrasive and parts being processed which cuts tumbling time and reduces or eliminates impingements of parts.
4. Light weight per cubic foot, requiring less weight to fill barrel and avoiding roll in or roll over of edges of parts.
5. Wears away evenly, does not chip or fracture thereby eliminating the presence of small chips to lodge in holes.
6. Maintains shape. Triangular shape is maintained and it wears so abrasive shapes can be resized for applications requiring the next smaller size.
7. Chemically inert, not affected by acids, compounds or detergents.
8. Easy to specify proper size thereby simplifying job set up.

Tumblex T is available in four sizes 4, 3, 2 and 1 (⅜", ⅝", ⅞", and 1⅛" measured on the side of the tri-



angle and ranging in width from 3/16" to 5/16"). Weight per cubic foot of the new moulded shape is 85 pounds.

Tumblex N is especially suited for use on die-cast items. Conventional tumbling abrasive has just too much cut for this application. Because it cuts slower and has little breakdown, Tumblex N does not mar the surface. It also brings up a bright color and luster.

This natural stone also brings up a good color on steel parts as well as zinc, brass, aluminum and stainless steel.

Lapidarists, both amateur and professional, are using Tumblex N as a low cost method of turning out beautifully polished barouques of agate, quartz, tourmaline and many other semi-precious stones with a minimum of hand labor or expense. Pigments for paints are also prepared in this manner.

It is often used with small amounts of loose abrasive where additional cutting action is required. The loose abrasive can be flushed out of the barrel and Tumblex N used alone for finishing. It is available in seven standard sizes ranging from 3/16" to ⅜" through 1⅜" to 2½". •

Use HAND Postpaid Card. Encircle No. 102

Gritted Cloth Wheel in New Large Sizes

The Grind-O-Flex Wheels, formerly available only in six inch diameters, are now made in 10" and 12" diameters for mounting on buffing lathes and heavier polishing and deburring operations.

In the coarse grit grades, the wheel is capable of fairly heavy flash removal operations; in the fine grits, it polishes contoured pieces to a plating finish.

Because the grit is embedded in the cloth, the wheel never needs regritting and the "scratch" is absolutely uniform for the entire life of this long-lasting wheel. Merit Products, Inc., 4023 Irving Place, Culver City, Calif. •

Use HANDY Postpaid Card. Encircle No. 103

There's a new look in Hartford's Tumbling Barrels... but underneath you get the famous Triple Action Barrel originated by Hartford and unsurpassed for doing a better job ...faster...at lower cost.

Compare these advantages! The Hartford fully enclosed Model 1956 is extremely compact . . . requires less floor space than most enclosed barrels. With Hartford the power unit is on top, where it belongs for long life, cleanliness and ease of maintenance. Barrel is mounted on rugged "A" frame for maximum strength. Streamlined steel enclosure confines splash and contributes to safe operation. Pivoted front guard opens to permit quick, easy loading and unloading . . . plus easy removal of barrel assembly. Standard power unit has four speed gear shift transmission. Literature and prices promptly furnished.

Hartford
PRECISION BALLS • RETAINERS
BEARINGS • TUMBLING BARRELS

HARTFORD STEEL BALL CO., INC., 21 Jefferson, W. Hartford 6, Conn.
Encircle No. 220 on postpaid card

FREE TRIAL OFFER
NO STRINGS ATTACHED

A VALUABLE KIT
Carton contains 6 grades of ultra-fine quality, assorted fine grit abrasive compounds suitable for a variety of work. Coarser grit compound can also be supplied.

6 LIBERAL JARS DIFFERENT GRADES

FOR PRECISION LAPPING

Here's a get-acquainted offer you cannot afford to miss. Among these samples will be found the answer to many a tool room lapping problem. Hard and soft abrasives for all kinds of lapping needs. Sent post paid anywhere in the U.S.A. and Canada.

OFFER LIMITED to those writing on company letterhead

No obligation—write today on your company letterhead.

PROVE THEM AT OUR EXPENSE!

UNITED STATES PRODUCTS CO.
518 MELWOOD ST. USP PITTSBURGH, PA.

Encircle No. 221 on postpaid card

RUST-LICK

grinding coolant concentrate

FOR GRINDING FERROUS METALS

The use of aqueous amine nitrite solutions as grinding coolants, with or without wetting agents, are becoming more and more widely accepted as a replacement for soluble oils.

Here are a few advantages:

1. FREER WHEEL-CUTTING ACTION.
2. COMPLETE VISIBILITY THROUGH CLEAR SOLUTIONS.
3. COOLER ACTION—LESS DISTORTION.
4. PERMITS THE USE OF HARDER AND FINER WHEELS.
5. ELIMINATES RANCIDITY, DERMATITIS AND FOAM.
6. PREVENTS RUST AND STAINING OF FERROUS METALS.
7. LOWERS COST OF SOLUTION—INITIALLY AND THROUGH LESS FREQUENT CHANGES.

write for free sample and brochure No. 35 to:

PRODUCTION SPECIALTIES, INC.

755 BOYLSTON ST. BOSTON 16, MASS.

Encircle No. 222 on postpaid card

aluminum oxide flours

precision graded

to micron sizes in grade Nos.

280
320
400
500
600
800
1000
1200

For lapping, honing and polishing operations where precision and uniformity are a must.

"MICRO-GRADED" ABRASIVES manufactured by:

K. C. ABRASIVE COMPANY

P.O. Box 4335 3101 Peery Ave.

Kansas City 27, Missouri

Write for prices and samples

Encircle No. 223 on postpaid card

HANCHETT new HY-POWER grinder

for

SHEAR BLADES · KNIVES · FLAT SURFACES

HYDRAULIC TABLE DRIVE

MOTORS: 30 h.p. to 75 h.p. CAPACITY: 60" to 296"

GRINDING WHEELS: 30" or 36" diameter segmental

FULL AUTOMATIC CONTROLS • POWERFUL • ACCURATE

HANCHETT MANUFACTURING COMPANY

World's Largest Manufacturer of Knife Grinding and Saw Sharpening Machinery

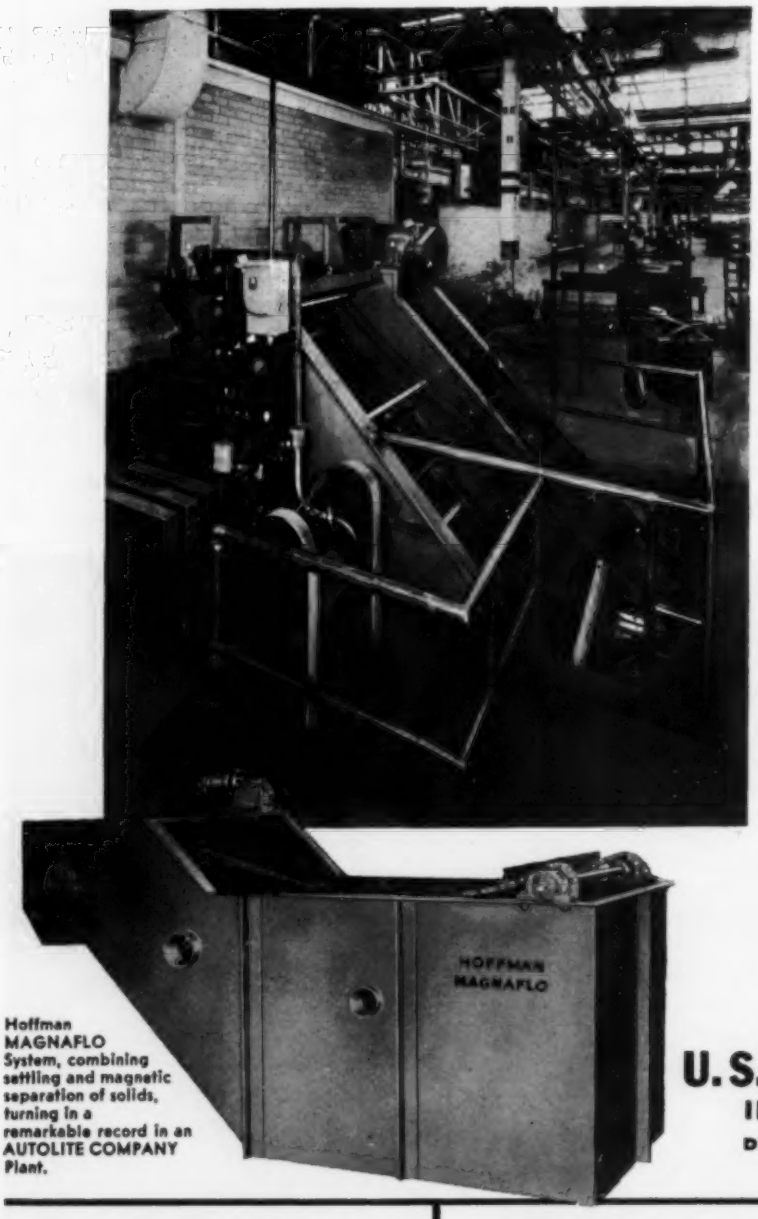
MAIN OFFICE — Big Rapids, Michigan WEST COAST — Portland 1, Oregon

HANCHETT GRINDERS BIG RAPIDS MICHIGAN

Encircle No. 224 on postpaid card

HOFFMAN'S ENGINEERED SYSTEMS designed to do the tough jobs in industry

FILTRATION AND CLARIFICATION OF INDUSTRIAL OILS IMPROVE MACHINE TOOL PRODUCTION UP TO 40%



Hoffman MAGNAFLO System, combining settling and magnetic separation of solids, turning in a remarkable record in an AUTOLITE COMPANY Plant.

Precision machining and grinding operations often mean costs and complications with coolant oils. However, many plants have installed a Hoffman Coolant Clarifier—and enjoy a tremendous gain in machine efficiency, and coolant economy.

Hoffman Coolant Clarifiers function automatically, assure maximum retention of coolant — with sludge discharged in near-dry state, and keep the machines supplied with abundant *clean* coolant oil. The results are better work, longer machine runs with less dulling of tools or fouling of grinder wheels, and addition of less new coolant.

Different processes are used in Hoffman Clarifiers—continuous belt vacuum filtration, aeration-flotation that floats the solids to the surface for skimming off, deep well settling with solids removed from the bottom, magnetic separation for ferrous particles, and pressure filtration. *Every* Hoffman Clarifier is designed for the best, most economical handling of the particular situation.

If handling coolant, lubricating, diesel fuel, or insulating oil is causing difficulties in your plant, see how easily a Hoffman System can end your troubles. Write or wire:

U. S. HOFFMAN MACHINERY CORP.
INDUSTRIAL FILTRATION DIVISION
DEPT. GF, 105 FOURTH AVE., NEW YORK 3, N. Y.

AIR APPLIANCE DIVISION

Multistage Centrifugal Blowers and Exhausters
Pneumatic Conveying Equipment
Industrial Vacuum Cleaning—Portable and Stationary Systems
Continuous Metal Strip Driers
"Smoothflow" Fittings and Tubing

METAL FINISHING DIVISION

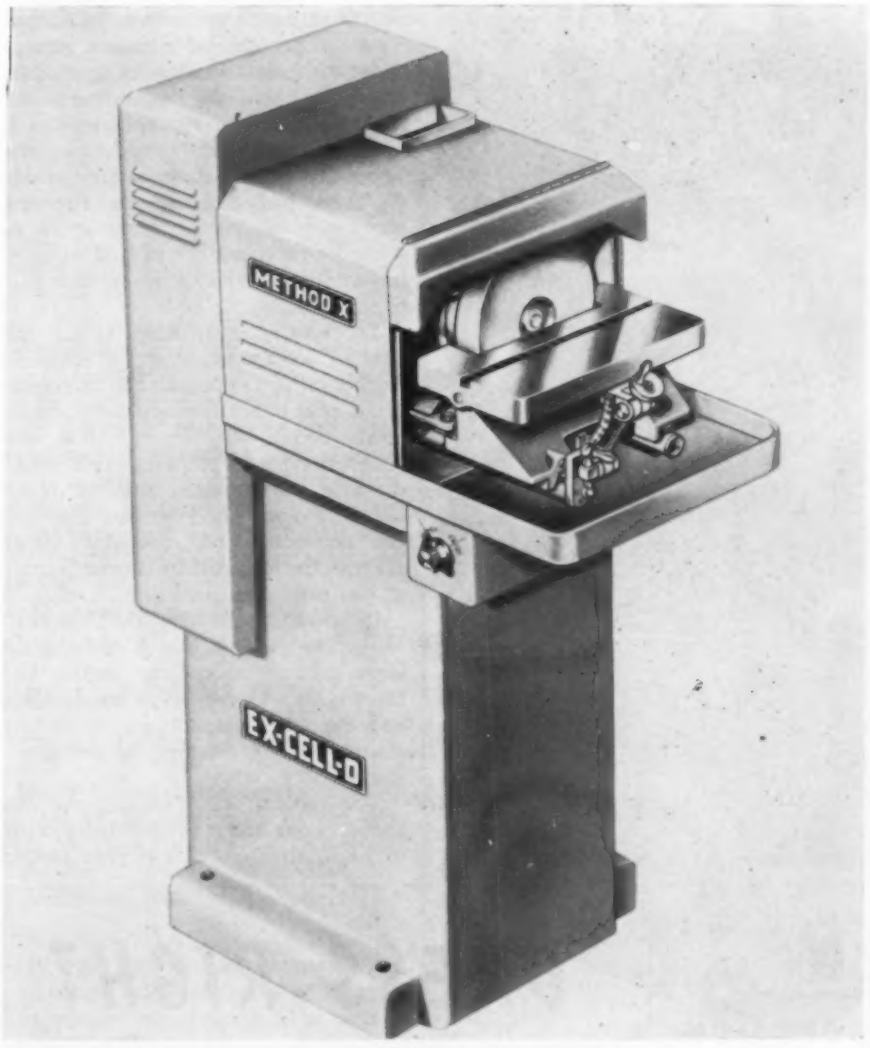
Mechanized Metal Cleaning and Phosphatizing Systems
Chemical Plating Equipment
Electrostatic Spray Painting Equipment
Paint Booths and Bake Ovens
Filters for Phosphate and Plating Solutions—Waste Disposal

ORDNANCE EQUIPMENT DIVISION

Special Pneumatic Conveying Systems
High Efficiency Centrifugal Separators
Stationary and Portable Vacuum Cleaning Equipment
Process Equipment
Pneumatic Systems for Radioactive Materials

Encircle No. 225 on postpaid card

Machine Sharpens Carbides Without Diamonds



Sharpening carbide tools by electro-spark machining instead of abrasive wheels is a revolutionary process now offered to industry by Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich. Known as "Method X", the process is currently available in a new tool sharpener, Style 43, introduced by Ex-Cell-O at the Machine Tool Show held recently in Chicago.

Designed primarily for off-hand sharpening of single-point solid carbide and carbide-tipped tools, the new machine functions without diamond wheels or abrasives. Its operating principle is relatively simple. For a wheel, the machine uses a ten-inch cast-iron disc, connected to serve as the negative terminal of an electric circuit. Similarly connected, the tool itself becomes the positive electric terminal. A semi-solid dielectric film applied to the disc provides a spark gap of proper distance between those terminals. As the tool is oscillated across the wheel face, current pulsations are released as spark discharges. The high current densities of the single-pulse discharge overcome the tensile strength of the material and a minute particle is removed from the tool at this point. The resulting crater depth and diameter are proportionate to the energy discharged per pulse. Thus rough or finish cuts with resulting surface can be obtained by simply setting a power selector switch. Method X does not cause parallel or unidirectional tool marks, heat checks or grinding cracks.

Chief among features of the method is its capacity to work materials of extreme hardness. Hard steel, cast alloys and the carbides yield singly or in combination. If it is an electrical conductor, virtually any metal can be worked on the new tool sharpener. No coolant is used in the sharpening process.

Special operator skills are not needed for tool sharpening by the Method X process. Because the operation is much like conventional off-hand grinding, an experienced grinder can quickly adapt his knowledge to the new technique.

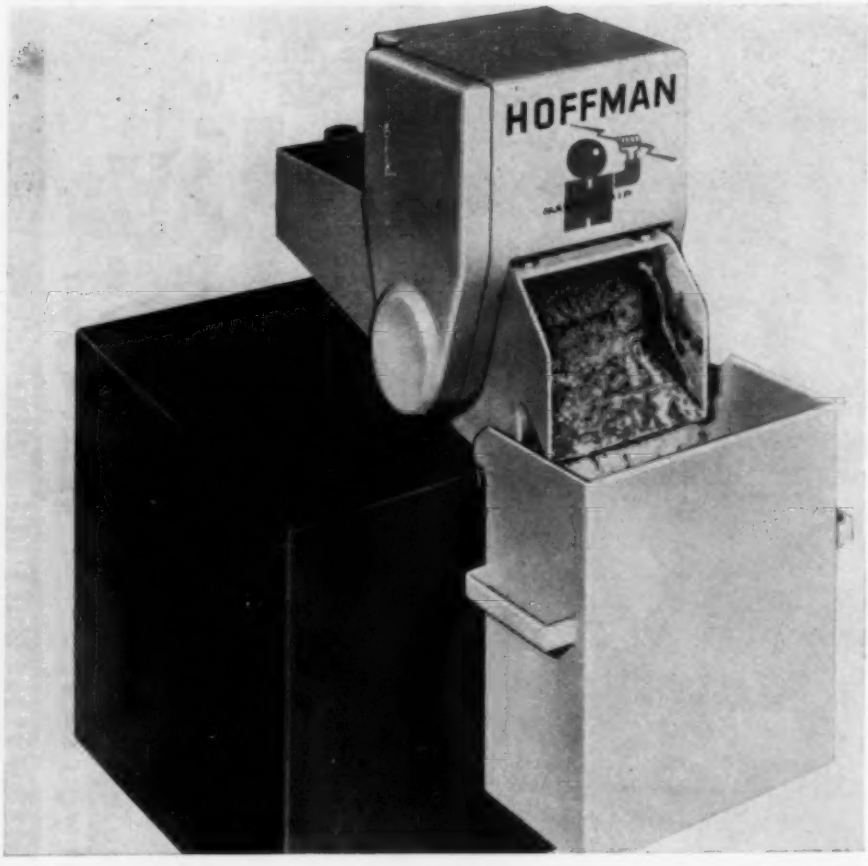
The new Ex-Cell-O Method X tool sharpener is built to NMTBA and JIC standards. •

Use HANDY Postpaid Card. Encircle No. 104

PRESSURELOK-224
RESINOID DIAMOND WHEELS
— the best diamond wheel bond ever developed —
if you've used them - you know they're best!
if you haven't - let us show you!
UNITED STATES DIAMOND WHEEL CO. AURORA, ILL.
US

Encircle No. 226 on postpaid card

Coolant Clarifier for Automatic Coolant Cleaning



The Industrial Filtration Div. of U.S. Hoffman Machinery Corp., 105 Fourth Ave., New York 3, N.Y., has expanded its line of filtration equipment with the addition of a coolant clarifier known as the Roto-Flo 15 Magna Grip. The Roto-Flo unit is a magnetic separator type clarifier designed for completely automatic cleaning of machine tool coolants. The unit requires absolutely no floor space as it can be mounted directly on existing coolant tank facilities or on any part of the machine.

The unit is constructed so that the flow of coolant is always in complete contact with a permanent magnetic drum as it passes through the clarifier. Drum speeds may be varied to suit different types of coolants. As a result, the unit assures better finishes, fewer rejects, longer wheel or tool life, and less down-time on machines. Other savings are recorded in coolant supply and in time spent in sump cleaning.

In operation, the Roto-Flo 15 is so effective and simple that it can clean a large volume of coolant swiftly and thoroughly. Operaton is continuous, and the unit does not clog or require shut-downs for cleaning or sludge removal.

The coolant, upon leaving the machine, passes under the revolving drum of solid Alnico, which is permanently

Now! SAFER

Cut-off Machine Operation

with the

***New* BULLARD!**

This outstanding machine is designed to give maximum safety . . . has many features:

- **Cutting Wheel Completely Enclosed**
- **Fast Production**
- **Economical Operation**
- **Close Work Tolerances**

Semi-automatic hydraulic operation is foot controlled, leaving both hands free.

Floor Space 24x42"

Write for circular and complete machine specifications TODAY!

BULLARD

Geo. H. Bullard

COMPANY INCORPORATED

HOPKINTON ROAD WESTBORO, MASSACHUSETTS

SPECIALTY MANUFACTURERS OF RESINOID BONDED HIGH SPEED GRINDING, CUT-OFF AND COPING WHEELS

Encircle No. 227 on postpaid card

DRESS RIGHT

More pieces ground per hour, more pieces per wheel . . . yours if you dress your grinding wheels regularly. Desmond dresser catalog free on request.

The only complete line of grinding wheel dressers and cutters

Desmond

THE DESMOND-STEPHAN MFG. CO., URBANA, OHIO

Encircle No. 228 on postpaid card

charged. Here, the coolant is directly exposed to the magnetic drum without interference from non-magnetic insulators. The drum, revolving against the flow of coolant passing below, uniformly and effectively attracts or separates the ferrous materials in the coolant. Separated material is removed from the drum by a non-magnetic scraper and is deposited in an easily-removed sludge pan.

The unit is driven by a 1/50 h.p. (max.) worm-gear speed-reducer motor equipped for 110-volt, 60 cycle current. It is also available with motors equipped for 220 or 440-volt operation. The Roto-Flo is chain driven with various sprockets supplied for different drum speeds. A motor driven squeegee or wringer synchronized with a drive-motor is furnished as standard equipment. The unit, including removable sludge pan is 28″ long, 23″ high, and 10¼″ wide, and has a gross weight of 108 lbs. •

Use HANDY Postpaid Card. Encircle No. 105

Reinforced Cut-Off Wheel Features Faster Cutting

Faster cutting speed combined with strength is the claim made by the Bay State Abrasive Products Co., Westboro, Mass. for its new Blue Flash, BF cut-off wheel for foundry applications.

New bonds and bonding processes permit an increase in abrasive grain content and allow grains to be bonded in a porous construction. The result is a sharper, faster cutting action.

Rough abrasive sides provide clearance to maintain wheel speed at best operating efficiency. The muscle needed for rugged foundry work comes from reinforcing layers of high tensile fabric. Recommended for steel, cast iron and non-ferrous metals through a wide range of grits and grades. Sizes available for all cut-off equipment. •

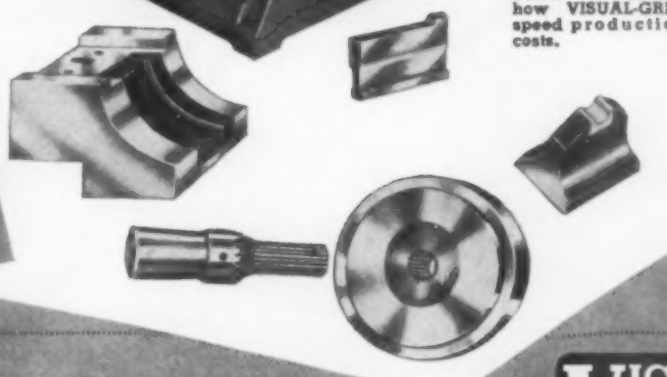
Use HANDY Postpaid Card. Encircle No. 106

VISUAL GRIND

...the Complete
PRECISION GRINDER
WITH CONTINUOUS WORK INSPECTION AND INFINITE PRECISION

OPTICS
TEMPLET
SCREEN IMAGE
COMPARATOR
WORK PIECE
SPECIAL DESIGN SURFACE GRINDER
BUILT TO SPECIFICATIONS
SIMPLIFIED GRINDING CONTROLS
PRICED UNDER...
(fill in coupon below, you'll be surprised)

Working with TUNGSTEN CARBIDE or Tool Steels—VISUAL GRIND will permit a semi-skilled operator to form-grind shapes such as are illustrated without continued comparator checking with the tool room—since this function is done to the built-in optical comparator. Fill in the coupon below — let us show you how VISUAL-GRIND will speed production — cut costs.



VISUAL GRIND

THE CLEVELAND GRINDING MACH. CO.
1643 Eddy Road Cleveland 12, Ohio

Gentlemen:

☐ Please have your representative call at our plant. The most convenient time would be (week) .....

☐ Phone for appointment.

☐ Please send us complete information on the NEW VISUAL GRIND.

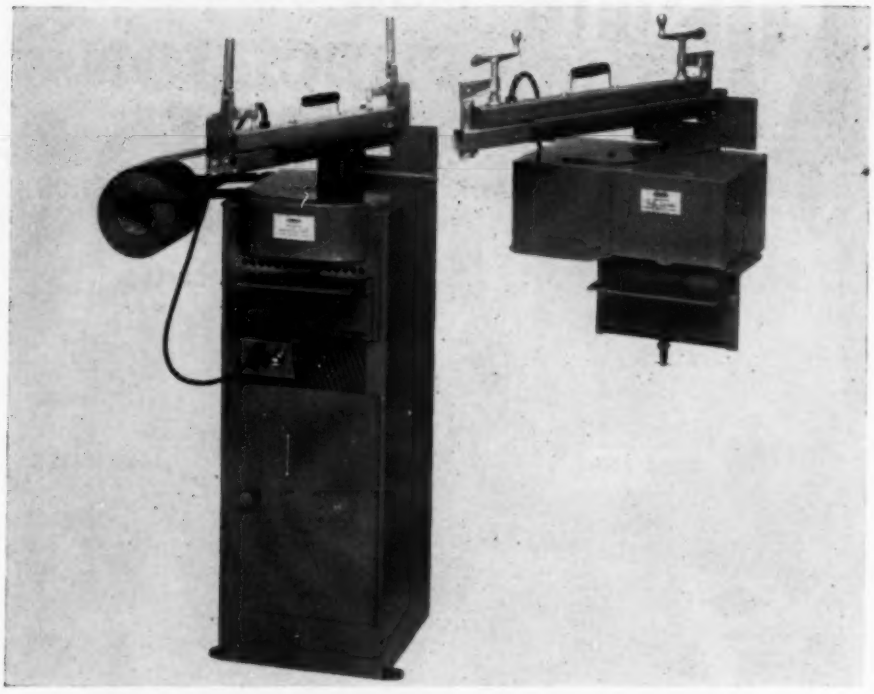
NAME..... TITLE.....

COMPANY .....

ADDRESS.....

Encircle No. 229 on postpaid card

Floor and Bench Model Abrasive Belt Splicer



The floor model is rigidly built to close tolerance, of heavy material, with a cabinet measuring 14"x14" and is 40" high. Cabinet contains two motors, a ball-bearing dust proof arbor and a dust collector.

This machine is operated on 110-125 volt, 60 cycle ac current. The floor model will be manufactured on order and will splice belts or sleeves of any length and up to 14 inches wide.

The bench model belt splicer is rigidly built to close tolerance and modernly finished.

The precision built ball-bearing arbor is dust proof. Arbor, motor and V-belt drive are entirely enclosed by a strong rigidly built hood. It is rubber sealed around arbor and grinding wheel compartment to keep out dust, and for quietness. A slide door is provided for access to skiving wheel.

The cutting and splicing jig may be used separately or conveniently mounted on hood.

The motor is 1-4 hp, G.E. or equal to that, 110-125 volt, 60 cycle, ac current. The bench model will also splice belts or sleeves of any length and up to 14 inches wide.

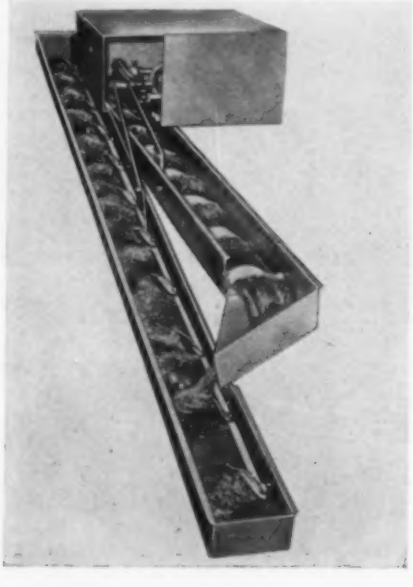
For information write Econaway Mfg. Co., 722 N. Main St., Bellevue, Mich. •

Use HANDY Postpaid Card. Encircle No. 107

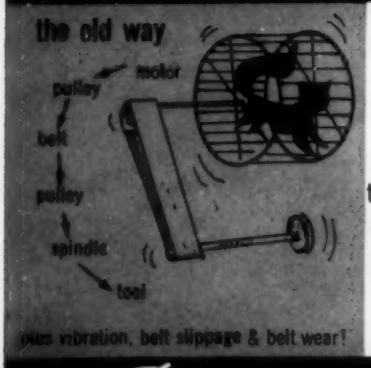
Shuttle-Type Conveyor

The Delpark-Jamesway shuttle-type conveyor operates on a single level without the necessity of a second level return as in the case of conventional conveyor belts. It is therefore more adaptable to many installations and is designed for many types of material handling. The simplified design makes it virtually foul-free.

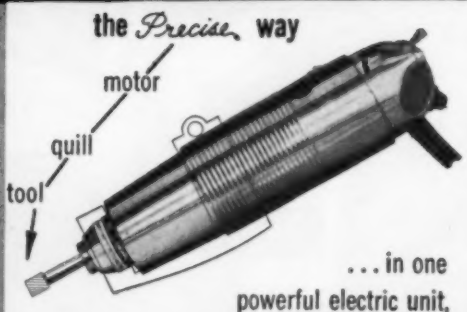
The conveyor operates within a trough or trench. A mechanically or hydraulically operated shuttle drive-bar rests on the bottom at either side or center. Hinged to the drive-bar at intervals are blades which open to the width of the trough as the drive-bar starts its forward movement. The blades advancing with the drive-bar move material in the trough to the maximum forward stroke of the drive-bar. As the movement is reversed, the blades fold back against the drive-bar and by-pass the material advanced by the blade in back. As the forward



Take the direct approach to versatile tooling!



plus vibration, belt slippage & belt wear!



...in one powerful electric unit, easily mounted!

Precise POWER QUILLS

- can finish to 5 micro inches and .0001" tolerances on Production Milling
- motor and spindle are in one compact, direct-line solid steel package with greater speed (45,000 RPM), torque, accuracy, and rigidity
- mount in any position on any machine, with Precise Mounts
- remove metal faster, increase tool life, better surface finishes

Precise Super 60 Power Quills operate at speeds up to 45,000 RPM, develop up to ½ h.p. and can be used to mill, grind, finish, or micro-mill any material with abrasive wheels or tungsten carbide tools. They outperform and outlast lathe grinders, and save fortunes with their tooling versatility.

Attach this ad to your letterhead for FREE demonstration or literature!

PRECISE PRODUCTS CORPORATION
1335 CLARK STREET, RACINE, WISCONSIN
Quality and precision since 1882

Grinder-Millers • Power Quills • High RPM Milling Machines • Mounts and Accessories • Rotary Tools

Precise

Encircle No. 230 on postpaid card

stroke is again begun, the blades open and advance the material in successive steps.

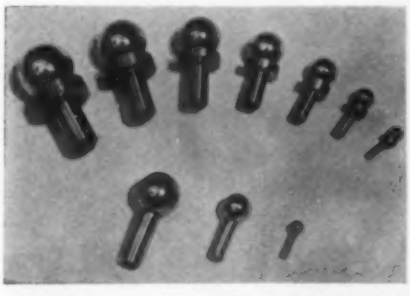
Conveyors are priced by the foot and engineered to the job. Trough and blade widths are in 2 inch progressive sizes from 6 inches to 30 inches. It is practical for installations of great length with extremely low head room requirements. Stroke can be adjusted hydraulically to advance fast and return slower or to advance slow and return fast.

Units can be made for portable use or for permanent stationary installation. Applications are for all industrial and heavy-duty material handling requirements. For complete information, write Industrial Filtration Co., Dept. J-478, Lebanon, Ind. •

Use HANDY Postpaid Card. Encircle No. 108

Two Types of Tooling Balls

Tooling balls that have shanks both with and without locating shoulders have been announced by Industrial Tectonics, Inc., Ann Arbor, Mich. These items are made of type 440-C stainless steel for protection against corrosion, and are hardened to 55-58 Rockwell C. Both types are carried in stock in ball sizes from ¼" through 1" by ⅛" increments.

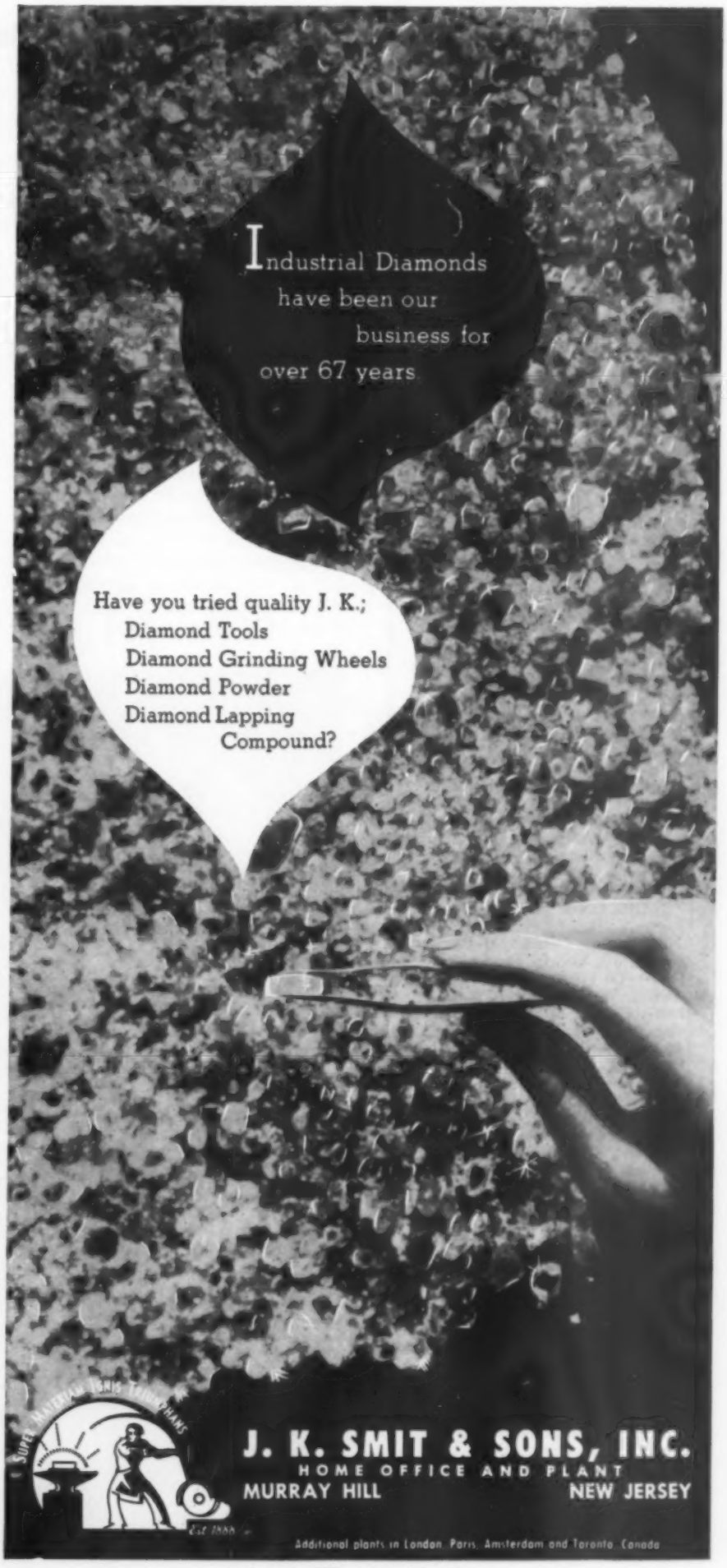


The balls with a plain shank are called fixture balls and are generally built into jigs and fixtures, where the center of the ball provides a positive locating point for positioning work in any plane. These balls are accurate to plus-or-minus .0001" on size, the shanks are held to plus .0000" minus .0003" on diameter, and the ball and shank are concentric to .0002" total indicator reading.

The balls with a reference shoulder (known as checking balls), are used for inspection purposes, and the distance from center of ball to bottom of shoulder is held to plus-or-minus .0002". The balls themselves are made to plus-or-minus .00002" on size, the shanks are held to plus .0000" minus .0002" on diameter, and the ball and shank are concentric to .0002" total indicator reading.

Tooling balls of both types can also be furnished in non-standard sizes or with other modifications as required. •

Use HANDY Postpaid Card. Encircle No. 109


Industrial Diamonds have been our business for over 67 years
Have you tried quality J. K.;
Diamond Tools
Diamond Grinding Wheels
Diamond Powder
Diamond Lapping Compound?
J. K. SMIT & SONS, INC.
HOME OFFICE AND PLANT
MURRAY HILL NEW JERSEY
Additional plants in London, Paris, Amsterdam and Toronto, Canada

Encircle No. 231 on postpaid card

District Managers
GRINDING and FINISHING

EASTERN DIVISION
Dan E. Reardon, V.P.
c/o Hitchcock Publishing Co
55 West 42nd Street
New York 36, N.Y.
Telephone: LAckawanna 4-4528

NEW ENGLAND, EASTERN N. Y. STATE
Dan E. Reardon, V.P.
Box No. 1 South Glastonbury, Conn.
Telephone: MEdford 3-7083
John Pickering
Box 148, c/o Hitchcock Publishing Co.
North Andover, Mass.
Telephone: LAwrence 8-0913

NEW YORK, METROPOLITAN AREA
Martin J. Gallay
Raymond J. Sietsema
c/o Hitchcock Publishing Co.
55 West 42nd Street
New York 36, N.Y.
Telephone: LAckawanna 4-4528

EASTERN PENNA., CENTRAL N.Y. STATE, N.J., MD., DELA., D. of C., BROOKLYN, N. Y.
Raymond J. Sietsema
c/o Hitchcock Publishing Co.
55 West 42nd Street
New York 36, N.Y.
Telephone: LAckawanna 4-4528
Home phone: VErona (N.J.) 8-7520J

CENTRAL DIVISION
Henry J. Smith, V.P.
c/o Hitchcock Publishing Co.
222 East Willow Avenue
Wheaton, Illinois
Telephone: WHeaton 8-3400

INDIANA, WESTERN OHIO, KY.
Henry J. Smith, V.P.
c/o Hitchcock Publishing Co.
222 East Willow Avenue
Wheaton, Illinois
Telephone: WHeaton 8-3400

MICHIGAN, NORTHERN INDIANA, TOLEDO, OHIO
James C. Stewart, V.P.
18055 James Couzens Highway
Detroit 35, Michigan
Phone: DI 1-9525 (Diamond)

ILLINOIS, WISCONSIN, IOWA, MINNESOTA, MISSOURI
Robert G. Bolinder
Marvin Matson
c/o Hitchcock Publishing Co.
222 East Willow Avenue
Wheaton, Illinois
Telephone: WHeaton 8-3400

WESTERN N. Y. STATE, WESTERN PENNA., EASTERN OHIO
Ralph E. Helfrick
1507 Edgefield Road
Cleveland 24, Ohio
Telephone: HIllcrest 2-0189

WESTERN DIVISION
CALIFORNIA, ARIZONA
Keith H. Evans
3723 Wilshire Boulevard
Los Angeles 5, California
Telephone: DUnkirk 8-2981 and
593 Market St., Room 304
San Francisco 5, California
Telephone: YUkon 2-4280

OREGON, WASHINGTON
Lloyd Thorpe
531 Medical Arts Building
Seattle 1, Washington
Telephone: Main 6827

HITCHCOCK PUBLISHING CO.
Telephone WH 8-3400
Wheaton, Ill.

Precision Flat Lapping Machine

A new, easy and simple to use, precision flat lapping machine has been announced by Spitfire Tools Co., 2931-35 N. Pulaski Rd., Chicago 41, Ill., which speedily produces the fine micro-inch finishes at amazingly low cost.

Designed by lapping engineers for highly accurate lapping of metals, glass, quartz, plastic and other materials, this machine, called the Spitfire "24", is ideal for finishing all manner of pieces requiring exceptionally flat and smooth surfaces such as sliding or rotating parts, gages, air-tight or liquid-tight seals and valves, measuring devices, load carrying bearings, plastic and die casting molds and drawing dies, sealing surfaces that must withstand high pressures or vacuums, and all other surfaces which must be held to extreme tolerances of flatness and smoothness.

The Spitfire "24" has a convenient working-bench height of 38" and consists of: (A) Revolving lapping plate, 24" in diameter and 2" thick, made of special, close grained cast iron, properly heat-treated and constructed to prevent distortion. Precision finished. Supported by 6 precision ground ball bearings. Top has grooved Archimedean spiral. (B) Housing. Heavy cast iron, accurately machined, mounts all mechanism. Aluminum cast gear box, holds bronze gears permanently lubricated and sealed. (C) Motor, ½ hp, heavy duty, 3 phase, 220-440, 1800 rpm. (D) Base. Heavy Steel. All parts are enclosed. The motor is accessible by means of a front door in the base. The entire machine occupies a floor space of only 25" x 25".

Any average machine operator or factory worker can perform precision lapping operations without having had special training. There are no chucks, collets, holders or tools needed. Moreover, as many as four operators may work at the Spitfire "24", thus providing additional means for reducing unit costs and speeding up assembly line precision lapping.

In use, the operator simply holds and

manipulates the work on the revolving abrasive-covered lapping plate, exercising just enough pressure to maintain the work in position. It may thus be seen that the heavy work of lapping is done by the machine, not the operator.

With small items, each operator may lap two pieces at once—one in each hand, as illustrated. Examination and measurement of the pieces may be accomplished quickly and easily while the machine is left running. Removal of surface marks, tool marks grinding fuzz or slight distortions and defects left by preceding operations are effected with speed and ease.

The Spitfire "24" now opens up vast new time-saving production applications at a low cost that is well within range of all. •

Use HANDY Postpaid Card. Encircle No. 110

Grinding Wheel Insert

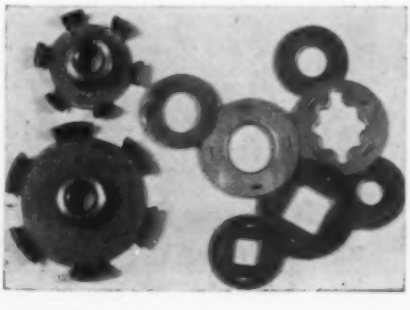
The Carroll-Lock type of cup grinding wheel insert was developed by the Carroll Pressed Metal Co., 138 Dewey St., Worcester, Mass., at the request of quality-minded grinding wheel manufacturers. The specific requirements included the design, development, and manufacture of a new insert assembly which would:

1. Increase the holding power between the threaded hub and anchor disc.
2. Improve concentricity and dimensional accuracy.
3. Increase the overall safety factor in operation.
4. Accomplish this without increasing price.

The most common method of joining the hub to the anchor disc has been to force the inside of the hub outward against the bore of the anchor disc, thus depending solely upon the resulting friction to hold the two parts together against the torsional forces of grinding or snagging.

Another method utilized a square hub staked into a square hole in the anchor disc. This hub was expensive, and the assembly characteristically showed poor concentricity and unsatisfactory holding power.

The disadvantages and defects of both these methods were most evident in severe applications of cup wheels, particularly in snagging operations. The hub might actually become loosened from the anchor disc. This not only presented a dangerous situation, but also rendered the wheel useless. Even slight relative motion between hub and anchor disc set up distortions which eventually led to fracture of the grinding wheel.



The answer to these difficulties, according to Roger C. Hager, chief engineer at Carroll Pressed Metal, was to substitute shearing strength for the friction formerly used to transmit the driving torque. This was accomplished in the Carroll-Lock insert assembly by lancing outward six sections of the steel hub into rectangular slots around the bore of the anchor disc.

Prototypes were made using temporary tooling. From these, techniques were developed to the point where full scale manufacture was practical. Torsional strength tests performed by the mechanical engineering department of the Worcester Polytechnic Institute showed 600% increase in strength over the traditional types.

In quantity production, close quality control is held over:

1. Concentricity of face to centerline of the thread.
2. Flatness of the face.
3. Close fit of the thread.
4. Squareness of the threaded hole and face.

For many years, Carroll Pressed Metal Company has supplied grinding wheel manufacturers with component parts. The close cooperation of these manufacturers has helped develop this new superior insert assembly which assures the grinding wheel manufacturers of better and safer grinding wheels. •

Use HANDY Postpaid Card. Encircle No. 111

"TUMBLING TOM" SEZ..
THERE IS NO NEED TO HURRY AND FRET,
FOR WITH A Globe YOUR NEEDS WILL BE MET,
IT TAKES THE EDGE FROM ALL THINGS ROUGH,
NO MATTER HOW FRAGILE, HEAVY OR TOUGH.

what's your finishing problem?

Let CASALBI's experimental engineering service analyze your parts finish needs. Send samples of parts and completed piece to show desired finish. CASALBI will provide detailed cost-saving finishing recommendations. Write today! No obligation, of course.

Write Dept. 33 for Tumbling Barrel Bulletin C-1

Casalbi Company

WEST GANSON & WAYNE • • JACKSON MICHIGAN

GLOBE tumbling barrels have been serving industry since 1902

Encircle No. 232 on postpaid card

Plano Interferometer Accurate to .0000005"

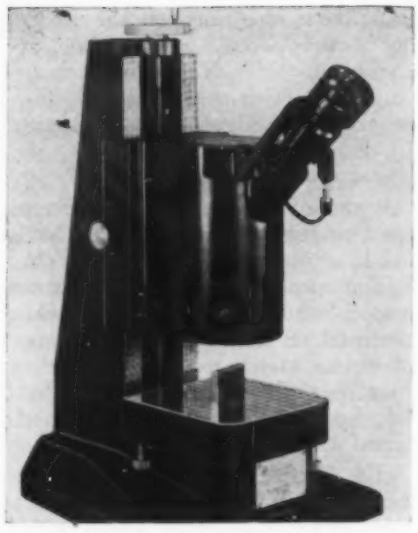
Davidson Manufacturing Co., West Covina, Calif., has developed a unique line of plano-interferometers capable of accurate use for production inspection.

Not much larger than the standard mechanical and visual measuring bench model instruments now in general use, Davidson plano-interferometers are easy to use, require no special housings or temperature control more than normal inspection department practice, yet offer accuracy of inspection to one half-millionth of an inch in surface flatness (.0000005).

Greatest advantage to users of optical testing equipment is the fact that with a Davidson plano-interferometer the work being tested never comes in contact with the optical flat. Thus no wear is registered on either the testing flat or the work under test. The test flat on the unit is safely housed in the machine and its surface flatness is measured against the tested work surface by visual process only, not by contact.

They are made in vertical and horizontal types for inspection of different shaped objects. The vertical interferometer will check any object up to 3 inches thick and 8 inches long. The working aperture of the instrument is 5 inches.

The horizontal interferometer will check objects from the thickness of paper to 6 inches thick which can be placed on the work table. One model of the vertical unit has a 6½ inch x 6¾ inch work table and a 2½ inch working aperture while a larger model offers an 8 x 8 inch work table and a working aperture of 5 inches diameter. •



Use HANDY Postpaid Card. Encircle No. 112

Brand New!

haskins

hask AIR Grinder...

most powerful air turbine grinder in its class!

75,000 R.P.M. (1/5 H.P. prony brake test)

- Permanently sealed bearings . . . never needs lubrication in air lines or grinder.
- Removable nose piece for deep grinding.
- Gyro action of turbine holds tool steady.

Here's power—SUSTAINED POWER—like you've never experienced before in an air grinder . . . power unexceeded by any other air grinder in the same price range . . . maintains its high-speed efficiency under load! Built with a lightweight, contoured, hand-fitting aluminum housing, the Haskins hask AIR Grinder handles easily, balances perfectly . . . excellent for the most precise grinding job. Complete kit includes: carrying case, adapter hose, mounted points, dressing stone and wrenches.

for Complete details WRITE

haskins

HASK-AIR HASK-FLEX

2649 W. Harrison St.
Chicago 12, Illinois

Encircle No. 233 on postpaid card

Automatic Clutch-Action Smooths Lapping Machine Operation

Lapping machines must start smoothly and during operation receive constant positive drive from the power source, without "chatter" or "grab." An automatic clutch assures smooth, dependable power input on the single-face flat lappers produced by the Norton Co., Worcester, Mass.

The clutch, designed by Mercury Clutch Div. of Automatic Steel Products, 1201 Camden Ave., S.W., Canton, 6, O., uses the inertia-delay principle for loadfull starting. Electric motors used to power the lappers develop maximum torque during the starting period, when direct coupling is least effective and torque requirement is greatest. During operation, over-size friction areas in the clutch assure positive power without slipping. The clutch slips constantly when an excessive overload is applied, preventing damage to motors and wiring.

The even-wearing friction surfaces and dynamic balance design of the Mercury clutch contribute to the long life of the Norton lapping machines. •

Use HANDY Postpaid Card. Encircle No. 113

USE THESE HANDY CARDS

TO OBTAIN LATEST DATA ON GRINDING AND FINISHING EQUIPMENT, PRODUCTS, TOOLS AND METHODS MENTIONED IN THIS ISSUE OF GRINDING and FINISHING

•

NO POSTAGE NEEDED

•

MERELY INDICATE THE ITEMS WHICH INTEREST YOU AND DROP CARD IN THE MAIL

•

THESE BUSINESS REPLY CARDS ARE FOR YOUR CONVENIENCE AND TO SAVE YOUR TIME

TEAR OUT THIS CARD AND MAIL . . . DEC., 1955

SEND MORE INFORMATION ON ITEMS ENCIRCLED:

LITERATURE:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	
34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	
52	53	54	55															
NEW PRODUCTS:	101	102	103	104	105	106	107	108	109	110	111							
112	113	114	115	116	117	118	119	120	121	122	123	124	125					
126	127	128	129	130	131	132	133	134	135	136	137	138	139					
140	141	142	143	144	145	146	147	148	149	150	151	152	153					
154	155																	
ADVERTISEMENTS:	201	202	203	204	205	206	207	208	209	210	211							
212	213	214	215	216	217	218	219	220	221	222	223	224	225					
226	227	228	229	230	231	232	233	234	235	236	237	238	239					
240	241	242	243	244	245	246	247	248	249	250	251	252	253					
254	255	256	257	258	259	260	261	262	263	264	265	266	267					
268	269	270	271	272	273	274	275	276	277	A1	A2	A3	A4					

Mr. ..... Title .....

Co. .....

Address .....

City ..... Zone ..... State .....

FIRST CLASS
PERMIT NO. 272
SEC. 34.9 P. L. & R.
WHEATON, ILLINOIS

BUSINESS REPLY CARD

GRINDING and FINISHING
A HITCHCOCK PUBLICATION
222 EAST WILLOW AVE.
WHEATON, ILLINOIS

TEAR OUT THIS CARD AND MAIL . . . DEC., 1955

SEND MORE INFORMATION ON ITEMS ENCIRCLED:

LITERATURE:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	
34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	
52	53	54	55															
NEW PRODUCTS:	101	102	103	104	105	106	107	108	109	110	111							
112	113	114	115	116	117	118	119	120	121	122	123	124	125					
126	127	128	129	130	131	132	133	134	135	136	137	138	139					
140	141	142	143	144	145	146	147	148	149	150	151	152	153					
154	155																	
ADVERTISEMENTS:	201	202	203	204	205	206	207	208	209	210	211							
212	213	214	215	216	217	218	219	220	221	222	223	224	225					
226	227	228	229	230	231	232	233	234	235	236	237	238	239					
240	241	242	243	244	245	246	247	248	249	250	251	252	253					
254	255	256	257	258	259	260	261	262	263	264	265	266	267					
268	269	270	271	272	273	274	275	276	277	A1	A2	A3	A4					

Mr. ..... Title .....

Co. .....

Address .....

City ..... Zone ..... State .....

FIRST CLASS
PERMIT NO. 272
SEC. 34.9 P. L. & R.
WHEATON, ILLINOIS

BUSINESS REPLY CARD

GRINDING and FINISHING
A HITCHCOCK PUBLICATION
222 EAST WILLOW AVE.
WHEATON, ILLINOIS

TEAR OUT THIS CARD AND MAIL . . . DEC., 1955

SEND MORE INFORMATION ON ITEMS ENCIRCLED:

LITERATURE:			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
52	53	54	55														
NEW PRODUCTS:			101	102	103	104	105	106	107	108	109	110	111				
112	113	114	115	116	117	118	119	120	121	122	123	124	125				
126	127	128	129	130	131	132	133	134	135	136	137	138	139				
140	141	142	143	144	145	146	147	148	149	150	151	152	153				
154	155																
ADVERTISEMENTS:			201	202	203	204	205	206	207	208	209	210	211				
212	213	214	215	216	217	218	219	220	221	222	223	224	225				
226	227	228	229	230	231	232	233	234	235	236	237	238	239				
240	241	242	243	244	245	246	247	248	249	250	251	252	253				
254	255	256	257	258	259	260	261	262	263	264	265	266	267				
268	269	270	271	272	273	274	275	276	277	A1	A2	A3	A4				

Mr. ..... Title .....

Co. .....

Address .....

City ..... Zone ..... State .....

FIRST CLASS
PERMIT NO. 272
SEC. 34.9 P. L. & R.
WHEATON, ILLINOIS

BUSINESS REPLY CARD

GRINDING and FINISHING
A HITCHCOCK PUBLICATION
222 EAST WILLOW AVE.
WHEATON, ILLINOIS

USE THESE HANDY CARDS

TO OBTAIN LATEST DATA ON GRINDING AND FINISHING EQUIPMENT, PRODUCTS, TOOLS AND METHODS MENTIONED IN THIS ISSUE OF GRINDING and FINISHING

•

NO POSTAGE NEEDED

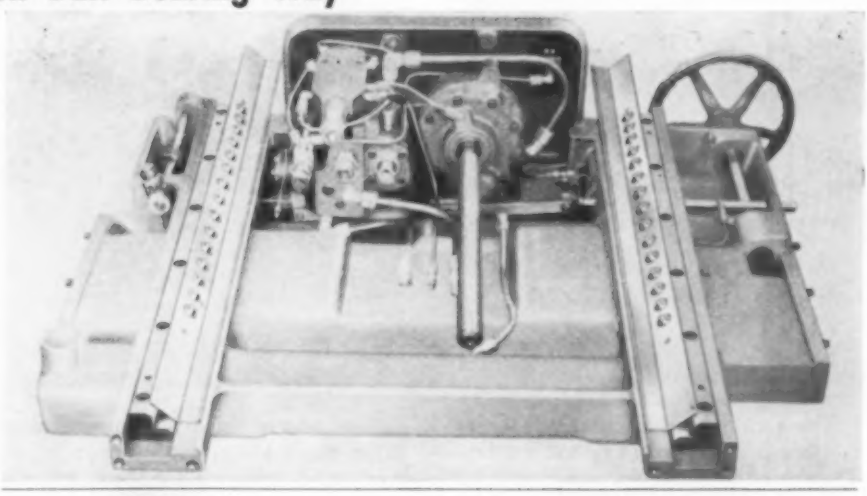
•

MERELY INDICATE THE ITEMS WHICH INTEREST YOU AND DROP CARD IN THE MAIL

•

THESE BUSINESS REPLY CARDS ARE FOR YOUR CONVENIENCE AND TO SAVE YOUR TIME

Cross Screw Feed Saddle on Ball Bearing Way



All surface grinders in the Abrasive Machine Tool Company's Hydrabrasive line are now equipped with a new precision cross feed screw and ball bearing saddle ways for smooth, precise saddle transverse adjustment. Hydrabrasives are now even more ideal for accurate slot grinding. The hydraulic drive feature provides quick acting vibrationless operation to table feed and saddle feed screw.

Ball bearings roll in square, rather than V channels, which completely eliminates table rocking and excessive wear. The pre-loaded bearings are packed in grease for lifetime lubrication. With this new design, the center line of work on the chuck never outtravels the full support of the saddle ways. This feature keeps work directly between saddle ways, thus eliminating overhang.

The saddle feed screw is precision ground and has a back-lash take up nut. Hydraulic power plus ball bearing saddle ways assure smoothness of operation for grinding to extremely close tolerances.

Abrasive Hydrabrasive grinders equipped with the new saddle cross feed screw and ball bearing ways are the No. 824, No. 1218 and No. 1224. Abrasive Mach. Tool Co., East Providence, R.I. •

Use HANDY Postpaid Card. Encircle No. 114

Water-Soluble, Transparent Grinding Compound

A new grinding compound, Cimplus, has been announced by the Cincinnati Milling Products Div., Cincinnati 9, O. It is a water-soluble, transparent concentrate that gives exceptional rust control at dilutions between 1:100 and 1:200.

Though used primarily as a transparent grinding fluid, Cimplus can also be used to advantage when machining cast iron. And it can be used in Cimcool mixtures for the added rust control needed in hard water areas. Information is available on request. •

Use HANDY Postpaid Card. Encircle No. 115

PARALLELISM *Plus**

- **MANUAL and AUTOMATIC** controlled hydraulic operation to work table. Can be arranged for complete automatic cycle grind.
- **TABLE MOUNTED Diamond Dresser** with dial control.
- **STEPLESS VARIABLE SPEEDS** to table and chuck rotation. Tiltable chuck.
- **HAND and AUTOMATIC WHEEL FEED** with power retraction.

Model E Hydraulic Rotary Surface Grinder (12 and 16" Chucks) has taken an honored place in the Arter Family of Machines after attaining a record of performance to which we point with pride.

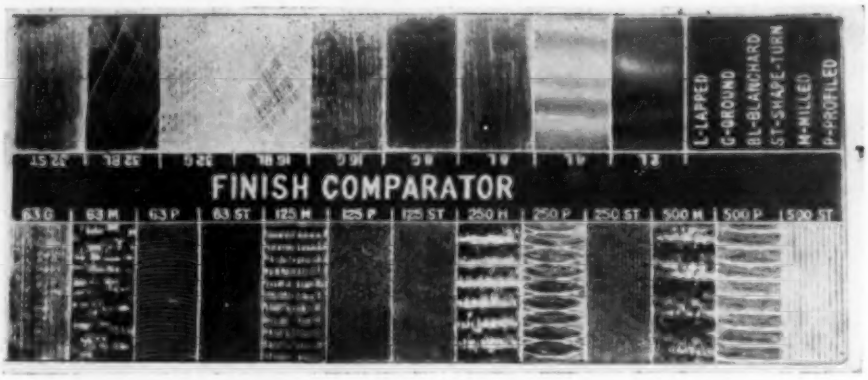
ARTER GRINDING MACHINE COMPANY
WORCESTER 5, MASSACHUSETTS

Jigmatic Automatic Tape Controlled Positioning Table • Rotary Surface Grinders
Flat Circular Cutter Grinders • Internal Grinders • Cylindrical Grinders • Carbide Tool Grinders

AGENTS IN INDUSTRIAL CENTERS OF UNITED STATES AND CANADA

Encircle No. 265 on postpaid card

Surface Roughness Scales



These scales have 22 different squares ranging from lapped to milled finishes. They come in a handypocket size, complete with leather case. The scales are made of rust resistant nickel.

How to use these roughness scales: Place the surface you want next to your work piece. Then both by eye and by the feel of your fingernail, compare the two surfaces.

Surface roughness control is important in reducing manufacturing costs. Over-finishing a bearing, for instance, not only wastes valuable time but will also cause overheating because the oil film cannot adhere to the surface. Under-finished bearings, conversely, increase friction, cause overheating, undue wear, and premature breakdowns.

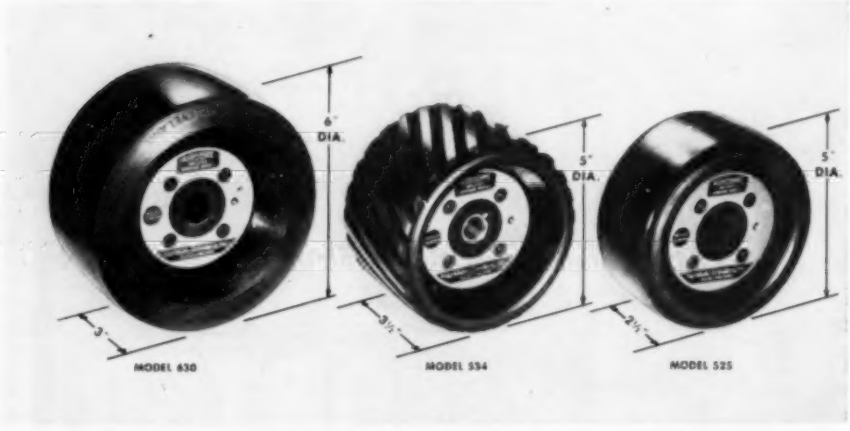
Pre-selecting your surface finish enables you to pre-select the quickest and cheapest machining method. If, for example, a 63 milled surface is required, there is no point in grinding at all, provided your miller can hold you dimensional tolerance.

In actual practice, here is what occurs.

1. Designer, observing his scale, specifies the required finish.
2. Draftsman, using his scale, notes the A.S.M.E-S.A.E. approved number on the scale and transfers them to print.
3. Methods man, using his scale, observes required finish. Selects fastest, and cheapest machining operations.
4. Machinist, checks in process work against his scale. He can also detect tool faults and dullness before bad finish occurs.
5. Inspectors use their scale as final check on finished part.

For further information write Montgomery & Co., Inc., 1 Tichenor Lane, Newark 5, N.J. •

Use HANDY Postpaid Card. Encircle No. 116



New Aircore Grinding Wheels

cut faster . . . feature interchangeable contact drums

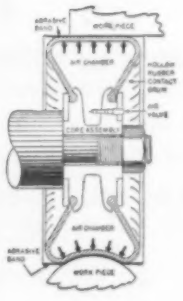
One universal core assembly and a range of contact drum sizes—these are the ingredients for a new line of Aircore Inflated Grinding Wheels. To change wheel sizes you simply change the drum. Complete changeover takes less than five minutes. All three models shown above are available with plain or serrated contact faces and can be used with all standard drive methods.

Because the contact area is always pliable, the wheel shapes itself to the contour of the work. Thus, you get up to 3,000% greater abrasive contact area than with hard-wheel grinders. This means a greater area finished with each pass.

As "set-up" wheels, Aircore Grinding Wheels provide complete uniformity of finish with no maintenance headaches. Inventories of buff sections, glue and grain are eliminated. Space required for the fabrication of conventional "set-up" wheels can be utilized for production work.

COMPARE AT OUR EXPENSE. Send for 25-day free trial. Give job requirements and type and size of power tool used.

N-118



The Aircore Inflated Grinding Wheel is built like an auto tire—flattens out at point of contact — contours to work surface.

NU-MATIC GRINDERS, INC.

8224 Carnegie Ave. Cleveland 3, Ohio

Encircle No. 234 on postpaid card

Two Zinc Compounds For Barrel Finishing

Two new barrel finishing compounds which the makers state will produce phenomenal results on zinc die castings have been announced by Morris S. Shipley, president of ESBEC Barrel Finishing Corp., 18 Beech St., Byram, Conn.

ESBEC No. 655 is a mild abrasive compound which produces ultra smooth surfaces in surprisingly short cycles and rinses completely at the end of the cut down run.

This is followed by a short burnishing cycle in ESBEC No. 205 burnishing compound which the makers state will produce ultra high lustre on all types of zinc alloys.

In many cases, where parts are being prepared for plating, ball burnishing can be eliminated by merely lengthening the honing cycle with ESBEC No. 205.

For the ultimate in color and lustre, however, the parts should be run in No. 205 with hardened steel balls or other burnishing media. •

Use HANDY Postpaid Card. Encircle No. 117

Grinding Head Features Universal Motion

Spiral Step Tool Co., 5404 N. Damen Ave., Chicago 25, Ill., manufacturers of special cutting tools, has recently introduced a new grinding head for use with cutter grinders, surface grinders and milling machines. The new device known as the Multi-Spiral universal grinding head is said to eliminate elaborate set-ups and make difficult grinding simple and easy.

It has a universal motion in an infinite number of directions. The spindle motion is adjustable straight in and out on a straight line with the center line of the spindle. While in this motion the spindle can be set to any spiral lead, right or left hand. Also, with the spindle moving in and out, the head can be set to move at right angles to the spindle motion, which makes it possible to grind tapers. The head motion can be used independently or simultaneously with the other.

The new unit is said to be ideal for grinding form relief, back-off work, straight or spiral flute-grinding. It can be used for complete sharpening of almost any type of cutting tool. Grind end mills, standard and long, ⅛" to 1¼" diameter; step drills; spiral step reamers and countersinks; spiral milling cutters to 2½" wide; angle milling cutters; form relief milling cutters; spiral shell mills; ball point end mills; hollow mills; trepanning tools; counterbores; flute grinding; staggered tooth and straight side milling cutters; recessing tools.

It is claimed that all operations, milling through grinding, from raw material to finished cutting tool, can be quickly and accurately done with this new device, which is available with or without base. •

Use HANDY Postpaid Card. Encircle No. 118

"There exist limitless opportunities in every industry. Where there is an open mind, there will always be a frontier."

—Margaret Lee Rumbeck

Diamond Tool for Thread Grinding Wheels

The illustrated diamond impregnated tools are designed specifically for dressing thread grinding wheels. The tools are available in all types of holders for thread grinding machines that grind sharp "V" or straight line threads. The protruding diamond impregnated matrix offers a cutting face in any direction.

This newly developed matrix has sufficient strength to extend beyond the actual tool end shown in the cut away illustration above. This additional strength factor entails less cold roll steel in contact with the grinding wheel. Therefore, the wheel "loading factor" is reduced to a minimum.

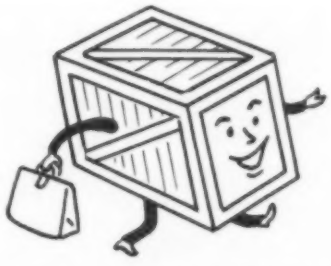
By properly designating the mesh size of diamond for the wheel in use,

very satisfactory results and cost savings are said to be possible.

Tools can be used in all classes of thread grinding, ranging from production line applications to gage, class five and close tolerance work. Tools can be reconditioned by grinding the face with a G.C. 80-18 Vw Carborundum wheel.

Engineering data is available for the proper tool on specific applications. Write to Diamond Products, Inc., 327 Prospect Ave., Elyria, O. •

Use HANDY Postpaid Card. Encircle No. 119



IMAGINE OUR SURPRISE!

. . . we shipped

A SALESMAN

to MARION MALLEABLE!

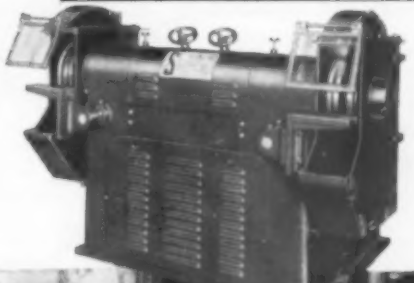
Yes sir, that FIRST Standard 35C Infinitely Variable Speed Grinder we shipped to Marion Malleable in Marion, Indiana SOLD 4 MORE IN LESS THAN A YEAR! When we asked grinding room Super Harold Williams about it, his answer was short — and mighty sweet: "WITH YOUR GRINDERS, WHEEL COST IS DOWN AND PRODUCTION'S UP!"

Here's the way it looks all dolled up in chart form:

Make of Grinder	Wheel Cost Per Ton	Avg. Hourly Production-Tons
Brand X	$3.20	.44
Standard No. 35C	**$1.75**	**.49**

IT'S THE STANDARD STORY WHEREVER YOU GO. Like we said "mighty sweet" ...FOR RAISING YOUR PROFIT CURVE.

SUPER SALESMAN!
The Standard No. 35C
Infinitely Variable Speed
SNAGGING GRINDER



Ask for literature and you'll see why it pays to Standardize with STANDARD!

HALLMARK OF METALWORKING THROUGHOUT THE WORLD

Since 1912

the STANDARD electrical tool co.

FOUNDRY GRINDER DIVISION
2478 RIVER ROAD • CINCINNATI 4, • OHIO

Encircle No. 235 on postpaid card

Surface Finish Comparators

Surface finish within the shop, is still being controlled to a considerable extent, particularly in the smaller plants, by surface roughness standards, which are commercially available. The comparison is often made by fingernail feel.

To improve the use of these standards, George Scherr Optical Tools, Inc., 200 Lafayette St., New York 12, N.Y. is now offering the Leitz comparison microscope.

It is a stereoscopic microscope which renders three dimensional vision for maximum definition. A split image of the master is compared visually against that of the work in any one of the three best suitable magnifications, namely, 16, 24 or 36X. To accentuate the finish characteristics, illumination may be directed either at right angles, or parallel, to the finish scratches by a convenient switch.

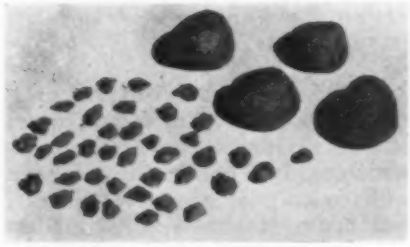
The use of this very modestly priced instrument will therefore, because of its magnification in three dimensions permit fast and accurate evaluation of surface finishes. •

Use HANDY Postpaid Card. Encircle No. 120

All-Purpose Tumbling Chip

Rough cut, fine finishing, coloring and burnishing is said to be possible with the new Lorco fused aluminum-oxide chip. The same chip can be transformed into a medium for coloring and burnishing.

For cutting, the fine pores of the chip must be kept from becoming glazed or loaded. Cleaned as recommended by a two-minute tumbling with Lorco compound GW, the chip will retain its original sharpness until



it wears down to fine dust. Other Lorco compounds are used to load the pores deliberately. In this condition, the chip will burnish as well as steel balls.

Chips are screened to range downward in sizes from 00 (2-in. to 1½-in.) to particles like grains of fine sand. Better and closer sizing for precision finishing has been provided by the addition of three extra half sizes: 1½ (⅞ to ¾-in.), 2½ (⅜ to ½-in.) and 3½ (⅜ to 0.279-in.). Below 3½, the grain sizes follow the standard mesh sizes of the U. S. Bureau of Standards down to No. 16 and even finer.

Lord Chemical Corp., 2068 S. Queen St., York, Pa. •

Use HANDY Postpaid Card. Encircle No. 121

Two Compartment Bins For Barrel Finishing Chips

Lorco two-compartment bins to hold aluminum-oxide chips for barrel tumbling are furnished with gates that assure positive control of the chip flow. Each gate is raised outwardly in a short arc from the wall of the bin so that the action of gravity will prevent any chips from interfering with the closing of the gate. The entire gate assembly is replaceable when worn.

The bins are furnished in three sizes:

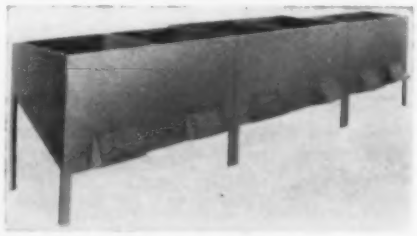
No. 2B-22 has two compartments, each having a volume of 22 cu. ft. Each compartment will hold approximately 1,400 lb. of chips; total capacity of bin 2,800 lb. Floor space occupied by bin is 25 by 48 in.

No. 2B-30 has 32-cu-ft. compartments, each holding approximately 2,000 lb. of chips; total capacity, 4,000 lb. Floor space, 31 by 56 in.

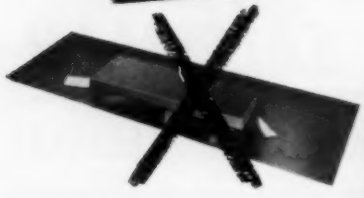
No. 2B-40 has 40-cu-ft. compartments, each holding approximately 2,600 lb. of chips; total capacity, 5,200 lb. Floor space, 36 by 60 in.

Lord Chemical Corp., Dept. O, 2068 S. Queen St., York Pa. •

Use HANDY Postpaid Card. Encircle No. 124



GRIND WARPED PIECES *Without* SHIMMING



No Guesswork!

Increased Production!

Save Time With

NEUTROLATOR

Holding Power REGULATOR and CHUCK CONTROL

Neutrolator Electro Magnetic Chuck Control provides regulation of holding power which permits grinding without shimming, to closer parallelism than ever before possible.
In production grinding where holding power must be the same with each work piece, Neutrolator reproduces the same tension on successive pieces without readjustment. Where various tensions are required, a simple dial or pushbutton control provides regulation of holding power. Neutrolator affords complete control of electro magnetic chuck at all times . . . protects chuck from harmful voltage surges . . . demagnetizes both chuck and work piece . . . facilitates easy removal of work, thus eliminates marred surfaces.

Write for Descriptive Circular

Telephone: BElmont 5-4010

ELECTRO-MATIC PRODUCTS CO.

2237 N. KNOX AVENUE CHICAGO 39, ILLINOIS, U.S.A.

Encircle No. 236 on postpaid card

Compact Coolant Chiller

A new line of compact coolant chillers incorporating the most efficient refrigeration system, is said to save valuable floor space, increase machine efficiency, accuracy and with higher production.

The Lundholm liquid chiller line includes both horizontal and vertical cabinet units made in sizes ranging upward from 5 gpm. The model X horizontal unit is made in sizes ranging from 2 hp through 7½ hp. They measure 46 inches long, 26 inches wide and 30 inches high. These units are designed for stacked multiple installations to save floor space and provide uninterrupted operation. The model H-T chiller vertical unit with a 7½ hp semi-hermetic unit is only 26 inches square, 50 inches high and will handle 30 gallons per minute with a 6 degree temperature difference.

All Lundholm chillers are made of welded steel frames and heavy sheet metal cabinets. Flexible vibration eliminators are installed on the refrigeration lines. High and low pressure controls are wired in series with the thermostat control and furnished with drier, expansion valve, combination pressure control, temperature control and water valve on water cooled models.

Units are completely assembled, charged with refrigerant and factory tested. Attractively finished in hammer gray baked enamel or machine gray. Lundholm liquid chillers of Rockford, Ill., are sold nationally by Industrial Filtration Co., Dept. LC-478, Lebanon, Ind. and their Delpark Filter representatives. Lundholm also manufactures special refrigeration equipment for industrial uses. •

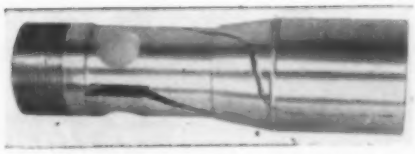
Use HANDY Postpaid Card. Encircle No. 122

Multiple Mandrel Sizes From One Basic Mandrel

Erickson Tool Co., which recently purchased all rights to Westberg Colletmandrels, has announced that the units are now in production and are being distributed through the same organization as other Erickson precision holding devices.

The manufacturer states that a number of design improvements have been incorporated in the Erickson-manufactured Colletmandrels. One of the most important improvements is that the Westberg Colletmandrel is now supplied so that it can be machined in place on the customer's equipment for greatest possible accuracy. This means that multiple mandrel sizes can be obtained from one basic mandrel size. The manufacturer further claims that the Colletmandrel is the only known commercial expanding mandrel that will grip in a hole as small as 3/16 inch.

This is a one-piece mandrel which operates as a reversed collet. All the advantages of a collet remain in the Colletmandrel since its one-piece construction grips and releases the work piece on its inside surface in the same



manner that a collet grips on the outside surface. It incorporates three stiff "fingers" which are twisted half a turn between the taper and the mandrel portion, thus causing a reversal of the gripping direction. Since this motion is now outward, the Colletmandrels have a powerful self-energizing action that tightly grips the inside surface of the work piece, and yet releases the part rapidly. One-piece construction means that maximum wall thickness is maintained since no drawpin is required.

Information available on request to Erickson representatives or to Erickson Tool Co., E. 23rd and Hamilton Ave., Cleveland 14, O. •

Use HANDY Postpaid Card. Encircle No. 123

NOW . . . HONE INTERNAL BORES
AUTOMATICALLY
WITH
FULMER HONING MACHINES

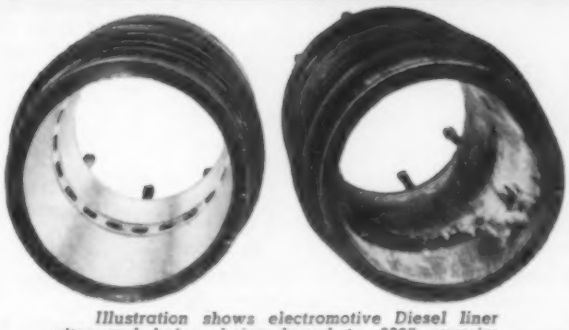


Illustration shows electromotive Diesel liner after and before being honed to .030" oversize

Fundamentally the same rugged, work - devouring dependable honing machines but with radical important changes.

You are assured:

NEW AUTOMATIC loading fixtures
NEW AUTOMATIC hone withdraw
NEW AUTOMATIC time cycle
NEW AUTOMATIC continuous, remote controlled feeding and retracting honing tools.

SAVINGS ON OPERATOR'S TIME . . .
LOWER COSTS . .
GREATLY INCREASED PRODUCTION

Available, of course, in regular manually operated types.
WRITE FOR DETAILS ABOUT THE NEW FEATURES

C. ALLEN FULMER CO.

1246 FIRST NATIONAL BANK BLDG. CINCINNATI 2, OHIO

Encircle No. 237 on postpaid card

Tough grinding jobs?

Check *Vulcanaire* high speed precision grinding heads!

Grinding circular slot using Vulcan's Rotary Table and Magnetic chuck.

Many seemingly impossible grinding problems have been solved by adapting Vulcanaire to standard machines or by using one of Vulcan's specially designed machines.

On Surface Grinders, merely remove wheel and guard, clamp vertical or horizontal adaptor to machine as illustrated. No belts necessary. For instance, Vulcanaire used in connection with Vulcan's Rotary Table for Surface Grinders permits the grinding of a circular slot.

Vertical adaptor for Surface Grinders. Grinding small slots

Adaptors are in stock to fit the spindle of Vertical Milling Machines for grinding contours, holes and slots.

On Internal Grinding Machines Vulcanaire's infinitely controlled speeds furnish the correct surface cutting speed resulting in faster production and micro finish. The adaptor sleeve fits into present housing.

Applied to Jig Boring Machines, Vulcanaire is liked by leading precision manufacturers because its accuracy is guaranteed, producing Vulcanaire jig grinding of large and small parts.

Horizontal application. Grinding a shoulder Punch.

Send us a blue print on your toughest grinding problem. Recommendations and sketches will be returned to you — no obligation.

Major Vulcan Services

Engineering, Processing, Designing and Building... Special Tools... Dies ... Special Machines ... Vulcamatic Transfer Machines ... Automation ... including the Vulcan Hydraulics that Form, Pierce, Assemble and size. ... Vulcanaire Jig Grinders ... Motorized Rotary Tables ... Plastic Tooling.

VULCAN TOOL CO.

743 LORAIN STREET • DAYTON 10, OHIO

Encircle No. 238 on postpaid card

Index to Advertisers

A

Abrasive Machine Tool Company (Surface Grinders) 5
Creamer-Trowbridge Company
Aget Manufacturing Company (Dust Collection Filters) 49
Beeson-Reichert, Inc.
Arter Grinding Machine Company (Grinding Machines) 69
John W. Odlin Co., Inc.

B

Barnes Drill Company (Coolant Filters) 17
Wendell C. Galloway
Bryant Chucking Grinder Company (Internal Grinders) 20
Henry A. Loudon Advertising, Inc.
Bullard Co., Inc., George H. (Cut-off Machines) 62
Ad-Service, Inc.

C

Carborundum Company (Grinding Wheels) 18, 19
Comstock & Co. Advt.
Casalbi Co. (Tumbling Barrels) 67
Guy C. Core Company
Chicago Wheel and Manufacturing Co.
(Mounted Grinding Wheels) 6
Frank C. Nahser, Inc.
Cincinnati Milling Machine Co. (Grinding Machines) 2, 3
Jaap-Orr Adv. Agency
Cleveland Grinding Machine Co. (Surface Grinders) 63
Ohio Advertising Agency
Clizbe Bros. Mfg. Co. (Bench Grinders) 37
Cortland Grinding Wheels Corp. (Grinding Wheels) 47
William B. Remington, Inc.
Crane Packing Company (Portable Polishing Stands) 52
George Holt Agency
Crystal Lake Grinders (Grinding Machines) 75
Cushman Chuck Company (Chucks) 53
Robotham & Peck, Inc.

D

Desmond-Stephan Company (Wheel Dressers) 62
Odiorne Industrial Advertising

E

Electro-Matic Products Company
(Electro-Magnetic Chuck Controls) 72
Munger-Spens Adv.
Elox Corporation of Michigan (Electrical Discharge Grinders) 4
Tech Agency
Erickson Tool Company
(Precision Expanding Mandrels) ..... Fourth Cover

F

Fulmer Company, C. Allen (Honing Machines) 73
Julian J. Behr

H

Hanchett Manufacturing Company (Grinding Machines) 59
Jaqua Advertising Company
Hartford Steel Ball Company (Tumbling Barrels) 58
The F. W. Prelle Company
Haskins Company, R. G. (Air Turbine Grinders) 68
Lester L. Jacobs, Inc.

J

Jeon Manufacturing Company (Dressing Tools) 49

K

K. C. Abrasive Company (Aluminum Oxide Flours) 59

M

Micromatic Hone Corp. (Honing Tools and Machines) 36
Gray & Kilgore, Inc.
Midwest Abrasive Company (Abrasives) ..... Second Cover
Marvin Hahn, Inc.

N

Norton Company, The (Grinding Wheels) 34, 35
James Thomas Chirurg
Nu-Matic Grinders, Inc. (Inflated Grinding Wheels) 70
Dwight Miller Co., The

P

Precise Products Corp. (Power Quills) 64
Allen Advertising Agency
Production Specialties, Inc.
(Grinding Coolant Concentrates) 59

Q

Queen Stove Works (Tumbling Barrels) 48
Alfred Colle

R

Rivett Lathe & Grinder, Inc. (Internal Grinding Machines) 38
Jones & Taylor and Associates

S

Simonds Abrasive Company (Grinding Wheels) 56
Fox & Mackenzie Advertising
Smit & Sons, Inc., J. K. (Industrial Diamonds) 65
Reid, Decker & Stockie, Inc.
Somerset Tool Company (Radius Dressers) 49
Reast & Connolly
Standard Electrical Tool Co. (Snagging Grinders) 71
Dinerman and Co., Inc.
Sterling Grinding Wheel Co.
(Grinding Wheels) ..... Third Cover
Central Advertising Agency

U

United States Diamond Wheel Company
(Resinoid Diamond Wheels) 61
U. S. Hoffman Machinery Company (Flotation Systems) 60
Mohr Associates, Inc.
U. S. Products Company (Grinding & Lapping Compounds) 58

V

Vulcan Tool Company (Grinding Heads) 74
Chester C. Moreland Company

W

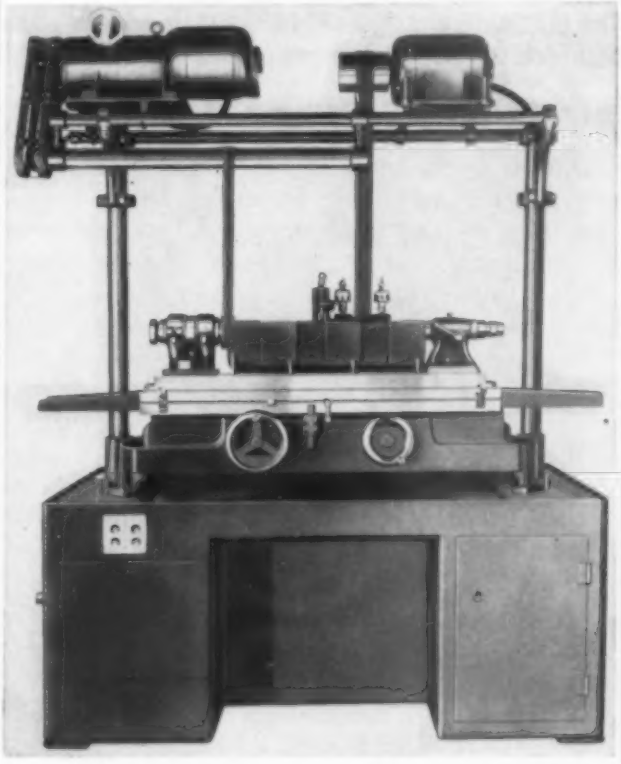
Walls Sales Corporation (Belt Sanders) 25
The Powered Company Advertising
Wheel Trueing Tool Company (Dressing Tools) 41
Clark & Robertz, Inc.
Woods Machine Company, S. A. (Precision Motors) 33
Harry M. Frost, Inc.

WHY AN OVERHEAD DRIVE?

When purchasing a Grinder you want roundness from .000005 to .000020, a finish from One to Five R.M.S. with immediate spark-out for fast production and ability to hold size from .0001 to .000010.

In order to accomplish this CRYSTAL LAKE uses double taper cone bearings that are pulled into solid bronze boxes.

CRYSTAL LAKE introduced their One R.M.S. Grinder in 1936 featuring their separate motor drive, eliminating cine-wave and providing ample power as a motor larger than wheel head can be used. To produce a One R.M.S. a heavy oil drag has to be placed on bearings. When a spindle is round and held tight in solid boxes, sizing is easy. Spindle, if necessary, can be stopped for measuring of small work, as motor recoil is taken up by springs on hinged motor plate.



As an example of the advantages of the overhead drive, we use our No. 1018 Universal Grinder which is equipped with a 2 horse power motor mounted overhead driving the wheel head spindle ninety degrees from grinding wheel pressure which keeps the bearings round and doubles their life. A one horse power drag is placed on a 2⅛" Diameter spindle so wheel will have to cut round. Bearings can be adjusted from time to time by using Dial Indicator to set end play.

Along with the two horse power on the Wheel Spindle a ¾ h.p. Speedranger is used on the Headstock so a ½ h.p. drag can be placed on double taper headstock bearings. Headstock will grind round from .000005" up.

Table can be moved easily as several hundred pounds are taken off table by this mounting.

Write for literature

CRYSTAL LAKE GRINDERS

Since 1910

CRYSTAL LAKE, ILLINOIS

Encircle No. 239 on postpaid card

$2,500.00 IN CASH PRIZES!

MACHINE and TOOL BLUE BOOK's

(Sister publication of Grinding and Finishing)

50th Anniversary

PRODUCTION CONTEST

Here's your opportunity to win $1,000, $500, $300, $200, or $100 in cash prizes!! As a part of the 50th Anniversary of MACHINE and TOOL BLUE BOOK, which celebrates its 50th birthday in January, 1956, the BLUE BOOK will sponsor a production contest open to everyone in the metalworking industry.
(The MACHINE and TOOL BLUE BOOK is probably known to the majority of our readers. It is published by Hitchcock Publishing Company, also publishers of GRINDING and FINISHING. The contest is open to *everyone*.)

Here's all you do:

1. Discuss in as many words as you need, any production technique or tooling idea or machining method used in your shop to increase production and/or cut costs. You'll merely want to describe the old method, the problem involved and the solution which answered the problem. Winners will be judged only on the job, or operation described and the savings which resulted.
2. The article need not be well written so long as the facts are there. Entries should be accompanied by photos and/or drawings. Drawings or sketches can be rough, penciled ideas.
3. Entries will not be judged on the basis of how well you write, draw, or how you present your material. The job is all that counts.
4. Attach an official contest blank to your entry and address it to: Contest Editor, MACHINE and TOOL BLUE BOOK, 222 E. Willow Ave., Wheaton, Ill. The entry blank appears on this page and will also be included in future issues of the BLUE BOOK. Additional copies of the entry blank will be sent on request.
5. Entries must be postmarked no later than January 31, 1956.
6. All entries become the property of Hitchcock Publishing Company. However, if any article does not win, and is still published in a Hitchcock publication, you will be paid regular contributor's rates for your material. So you can't lose!
7. Judges will be announced later.
8. There's no limit to the number of entries made by one person.

LIST OF PRIZES

1st Prize	**$1,000**
2nd Prize	**$ 500**
3rd Prize	**$ 300**
4th Prize	**$ 200**
5, 6, 7, 8, 9th Prizes, each	**$ 100**

YOU'VE DONE THE JOB. NOW WRITE ABOUT IT AND WIN $1,000 IN CASH!

MACHINE and TOOL BLUE BOOK'S 50th Anniversary Production Contest

OFFICIAL ENTRY BLANK

1. Everyone is eligible except employees of Hitchcock Publishing Company and their families.
2. Entry must discuss, in as many words as needed, a saving in cost, or time, made as result of an improved production technique or machining operation or tooling idea.
3. Entries should be accompanied by photos and/or drawings to better portray the job.
4. Contest opens November 1, 1955, closes February 1, 1956. All entries postmarked later than January 31, 1956, cannot be accepted.
5. The decisions of the judges are final.
6. In case of ties duplicate prizes will be awarded.
7. This contest is limited to residents of the continental United States.

NAME: _____

COMPANY: _____

HOME ADDRESS: _____

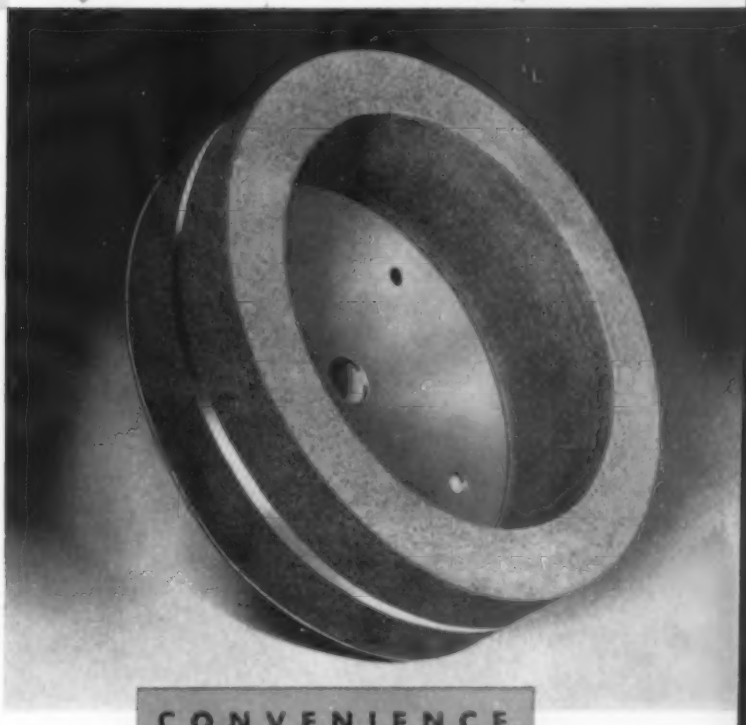
BUSINESS ADDRESS: _____

TITLE: _____

ECONOMY

two efficient ways

to solve the same problem !



CONVENIENCE

STERLING EASYMOUNT and PLATE MOUNTED WHEELS

provide equal winning performance

for carbide tool grinding

● For faster, expert carbide tool grinding, folks find record-breaking performance every time from the Sterling Twins—the Easymount or Plate-Mounted Wheel.

You cannot go wrong on either choice of abrasive tools. Many choose the Easymount for economy and others like the Plate-Mounted Wheel for its convenience. Both provide economical, more precise grinding of carbides every time.

Ask for a trial of either the Easymount or Plate-Mounted Wheel—or both! Sterling engineers will gladly show you how quickly either Sterling unit pays for itself.

Encircle No. 275 on postpaid card

"THE WHEELS OF INDUSTRY" STERLING ABRASIVES

STERLING GRINDING WHEEL CO., TIFFIN, OHIO

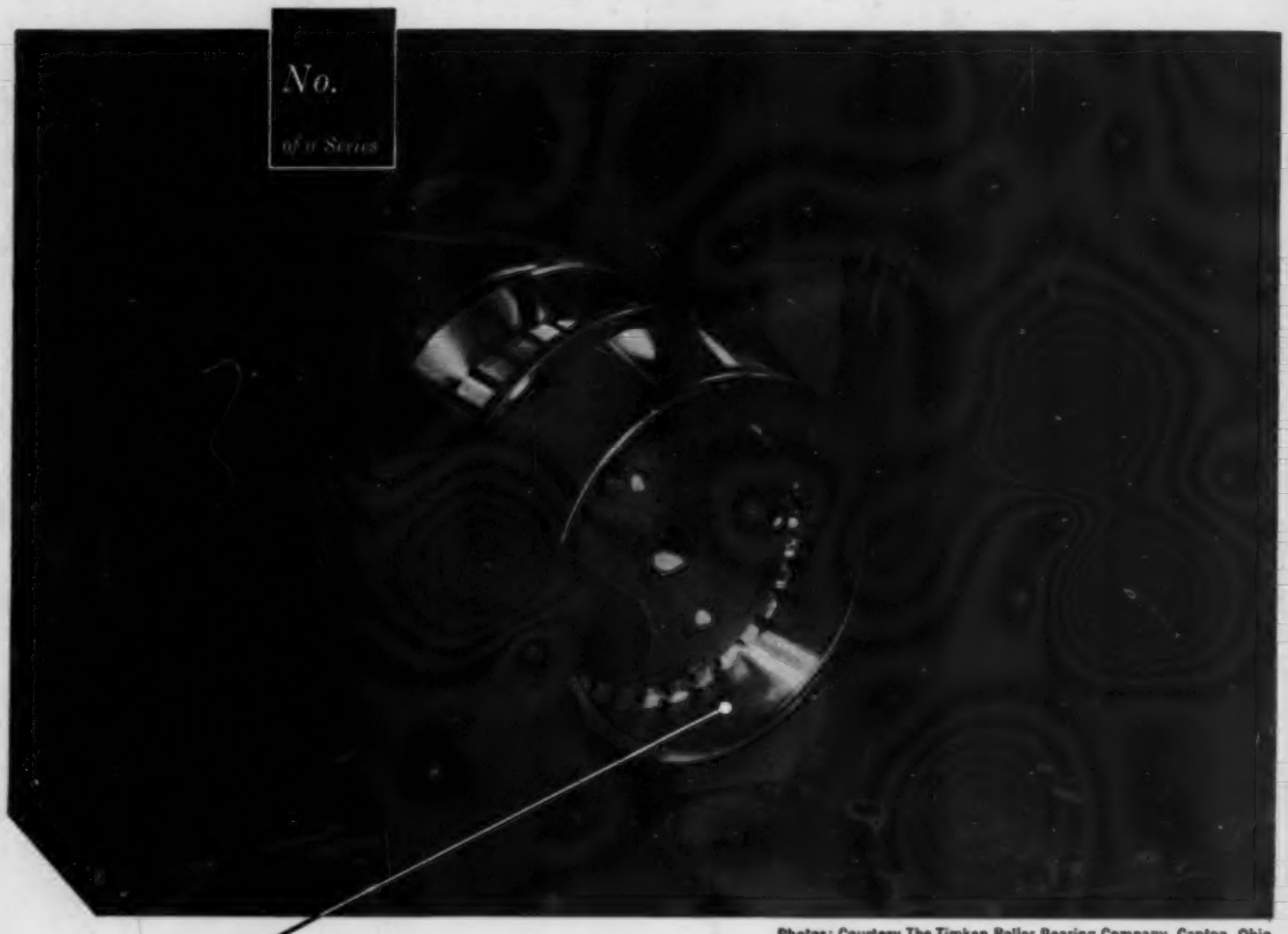
A SUBSIDIARY OF

ABRASIVE AND METAL PRODUCTS CO.

A&MP COMPANY

DISTRIBUTORS IN ALL PRINCIPAL CITIES

Erickson Precision Expanding Mandrels Solve Grinding Problems



Photos: Courtesy The Timken Roller Bearing Company, Canton, Ohio

e.g. roller bearing races

Unusual accuracy is required in the manufacture of tapered-roller bearings. That's why The Timken Roller Bearing Company, leading producer of tapered-roller bearings, uses Erickson precision expanding mandrels for rough and finish grinding of roller bearing races. For in addition to their ability to hold to closest tolerances consistently, they have instantaneous release feature that speeds loading and unloading—for real production dividends.

Let an Erickson representative show you how Erickson precision expanding mandrels can solve your grinding problems.

AA-8451

Collet Chucks
Floating Holders
Tap Chucks
Indexers

ERICKSON TOOL COMPANY

2310-10 Hamilton Avenue • Cleveland 14, Ohio

Tap Holders
Air-Operated Chucks
Expanding Mandrels
Special Holding Fixtures

Bothered by a tough internal holding problem? Then let us show you how Erickson mandrels speed production, lower grinding costs. Call us or write for Catalog K.

Encircle No. 276 on postpaid card